MODERN PLASTICS

APRIL 1945

LOOKING FOR A VERSATILE MATERIAL?

● The end bells illustrated above were manufactured by the Sampsel Time Control Company. Used as casings for covering the end connections of high speed electric machines, these small but vital items are no simple job to produce. The machine tolerances are quite close and the parts must have a high degree of stability. In fact the boring of a seat for a ball bearing is held to .0003" tolerance while one shoulder diameter is turned to .0008" tolerance.

As a result of an ingenious mold design, these end bells are molded in a single operation. Notice how the inserts are molded-in making for ease of assembly and fabrication.

The tremendous progress which America's custom molders have made during the past three years in developing new molding methods and processes is exemplified by the efficient production of just such items as these end bells

The material selected for these end bells was a general-purpose Durez phenolic molding compound. Besides possessing excellent moldability, this Durez compound possesses such versatile properties as oil and grease resistance, dielectric strength, self-insulation, excellent wearability and heat resistance.

The unusual versatility of Durez phenolics has made their usage practically universal throughout industry. Add to this the quarter century's experience which Durez technicians have acquired through active participation in the successful development of many plastic products and you can readily appreciate the benefits of working with our organization. The services of the Durez staff are available at all times to you and your custom molder. Durez Plastics & Chemicals, Inc., 264 Walck Road, North Tonawanda, N. Y.

DUREZ

PHENOLIC RESINS

- MOLDING COMPOUNDS
- INDUSTRIAL RESINS
- OIL SOLUBLE RESINS

PLASTICS THAT FIT THE JOB

PUBLIC LIBRARY

In another of its warfront roles

Catalin

serves as bodyguard to a detonator

A special type of detonator, resembling a fountain pen, developed by U. S. Engineers and fabricated by Plastic Turning Co., Inc., utilizes two Catalin castings to house-in and protect the element's firing mechanism.

The use of Catalin proved perfect for the application. Catalin is tough, dimensionally stable. It was also possible to obtain it quickly, in the quantity required, cast to exacting specifications—and in the correct color desired.

While urgent assignments like these affect the availability of Catalin for immediate civilian purposes, they need in no way postpone a get-together for the exchange of ideas relative to postwar planning. Catalin's technical staff will be very happy to render your inquiry a prompt response.

CATALIN CORPORATION

ONE PARK AVENUE, NEW YORK 16, N. Y.

CAST RESINS • LIQUID RESINS
MOLDING COMPOUNDS

Catalin

MODERN PLASTICS

AND PLASTICS

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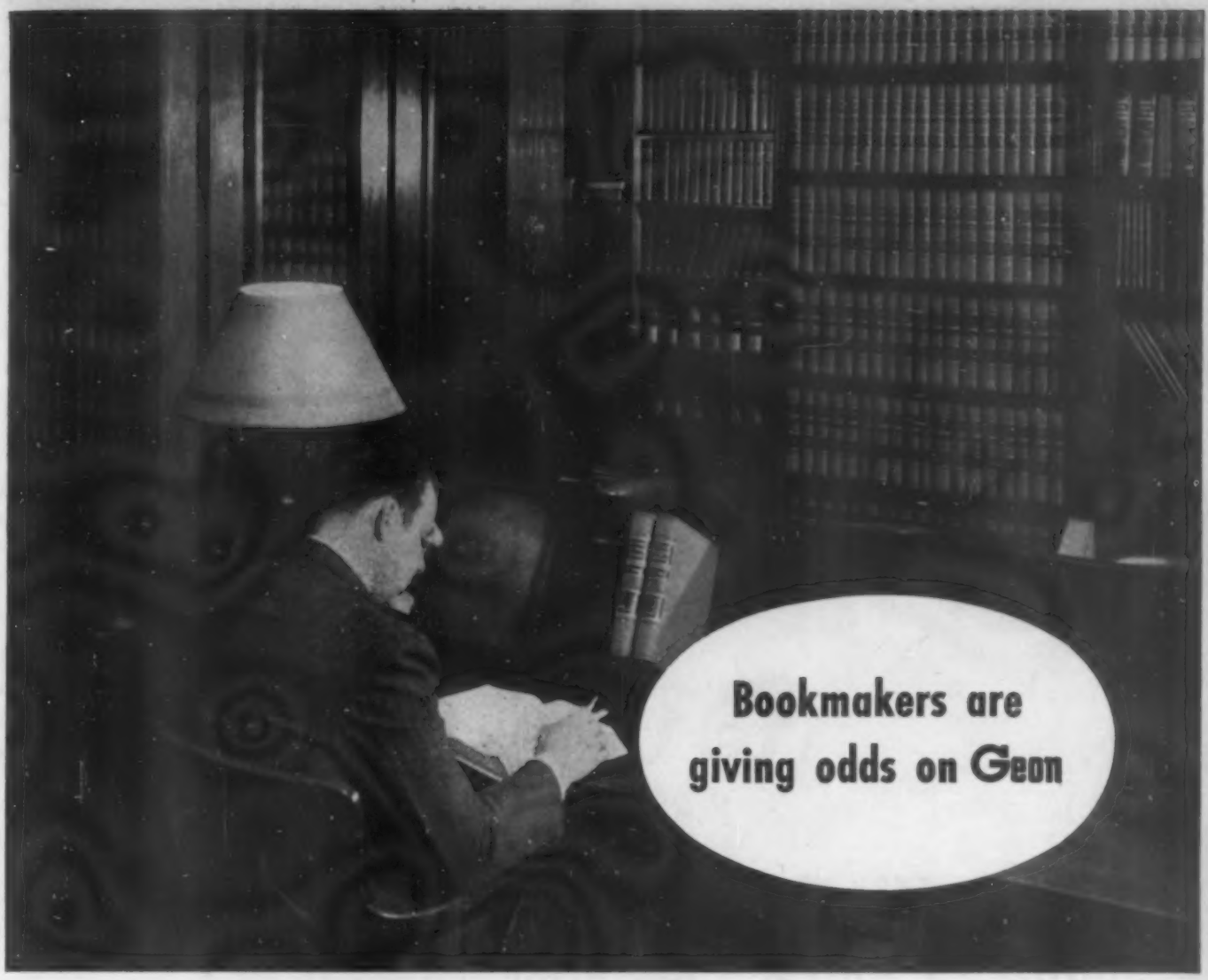


Because—with Geon it's the *combination* of properties that counts

IT'S BETTER than even money that GEON-coated fabric or paper—or flexible unsupported sheet—will be broadly used for book-binding when the GEONS are released for non-military applications. That's because a product made from GEON can be *planned* to include the properties needed.

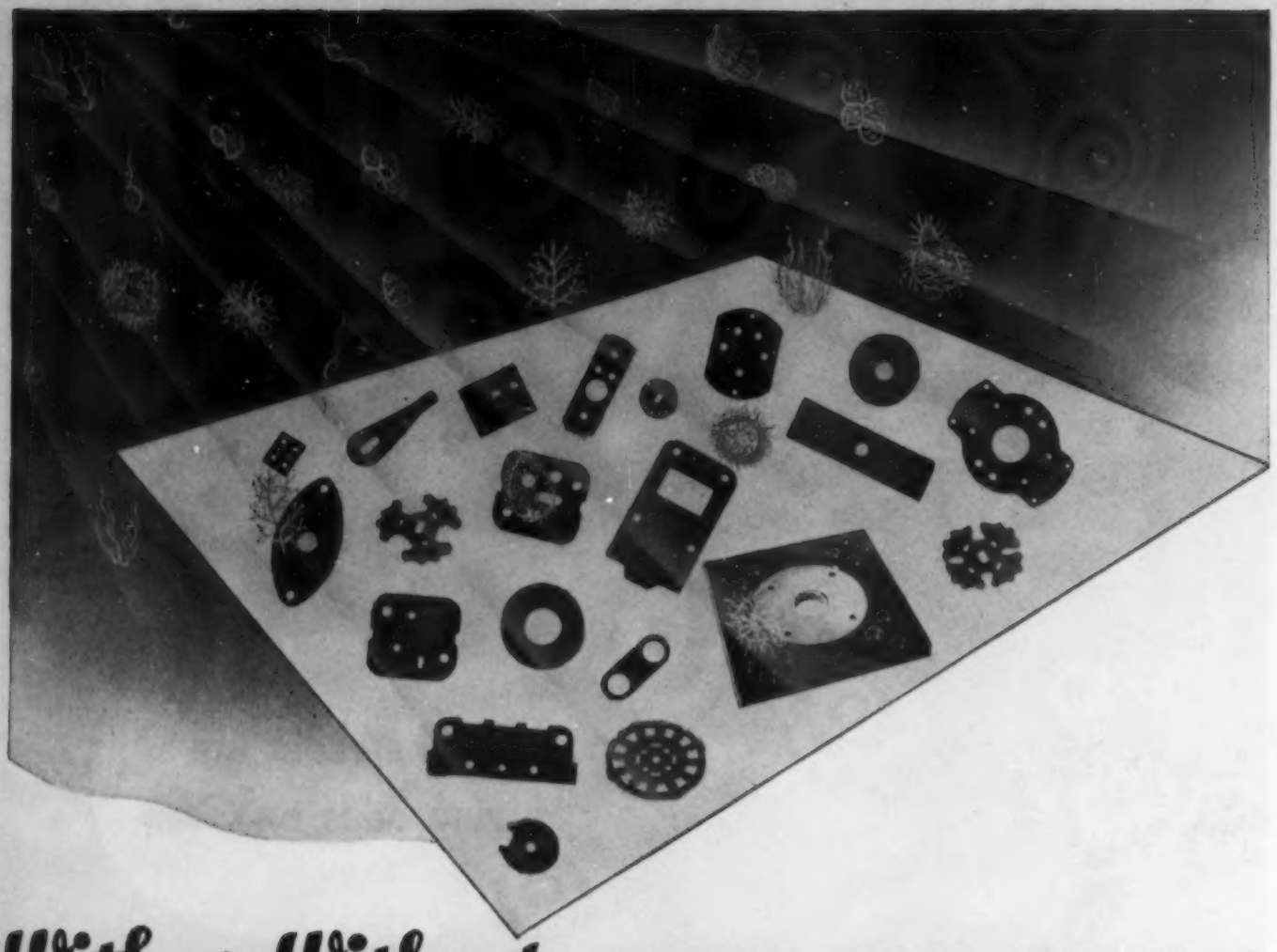
For example, the ideal book binding must wear well—particularly in public library service. Covers made from GEON will wear indefinitely, because of their excellent resistance to abrasion and their long flex life. They won't be appreciably affected by age, either . . . Books get dirty. Covers made from GEON will be waterproof, easily washed . . . Color is an important factor in the sale of books. GEON materials may be brilliantly—or delicately—colored . . . Many valuable book covers have been destroyed by mildew. GEON will be unaffected by mildew—discoloration will wash right off.

These and other properties of GEON—resistance to chemicals, foods, heat, cold, light and many other destructive elements, may be had in an almost limitless variety of *planned* combinations. GEON may be made into a wide variety of forms, too—coatings for fabric and paper; flexible sheet or film for packaging materials; brief cases, upholstery; flexible or rigid extrusions and molded goods for innumerable applications. Probably you can suggest additional applications for these truly versatile raw materials.

For more complete information about GEON polyvinyl materials, write Department II-4, Chemical Division, The B. F. Goodrich Company, 324 Rose Building, Cleveland 15, Ohio.

Geon
Polyvinyl Materials

CHEMICAL DIVISION
The B. F. Goodrich Company
324 ROSE BUILDING • CLEVELAND 15, OHIO



With or Without — PROTECTIVE FINISHES

. . . Insurok T-640 out-performs ordinary laminates!

So far as we know—there is no laminated phenolic plastic that has the *low moisture absorption* of Laminated INSUROK, Grade T-640! Scientific laboratory tests show it! On-the-job performance proves it! For in humid, tropical climates this Richardson Precision Plastic is daily showing its unique ability to outlast ordinary materials with *or without* protective finishes—in spite of devastating, ever-present fungus growths.

In addition, INSUROK T-640 has uniform dielectric and mechanical characteristics, and can be fabricated. With so many outstanding features, it's no wonder INSUROK T-640 shows up with increasing regularity today in specifications for radar, communications transmitters, receivers and many other products where moisture absorption must be cut to a minimum. Get the full story now! Write Richardson Plasticians today.

TESTS ON T-640—SANDED & UNSANDED
Made at Richardson Laboratories
Dec. 6, 1944

STOCK	T-640 SANDED	NOT SANDED
Thickness	.097	.126
Volatile	0.34%	0.29%
Moisture Abs.	0.56%	0.38%
Expansion	.0002	.0002
TESTS AT ROOM CONDITIONS		
Power Factor	.0322	.0333
Dielectric Constant	4.61	4.89
Loss Factor	.149	.162
Arc Test (Sec.)	130-128-129-126-123	129-60-117-12-64
TESTS AT 90% HUMIDITY 104° F.		
Power Factor	.0342	.0347
Dielectric Constant	4.77	5.06
Loss Factor	.163	.176
Insulation Resistance	122,000-98,000-122,000	98,000-162,000-122,000
Average	114,000	127,000

Insulation resistance was determined using taper pins. Sanded and unsanded samples were obtained from same factory sheet.

INSUROK *Precision Plastics*

The RICHARDSON COMPANY

MELROSE PARK, ILL. NEW BRUNSWICK, N. J. FOUNDED 1868 INDIANAPOLIS 1, IND. LOCKLAND, CINCINNATI 15, OHIO
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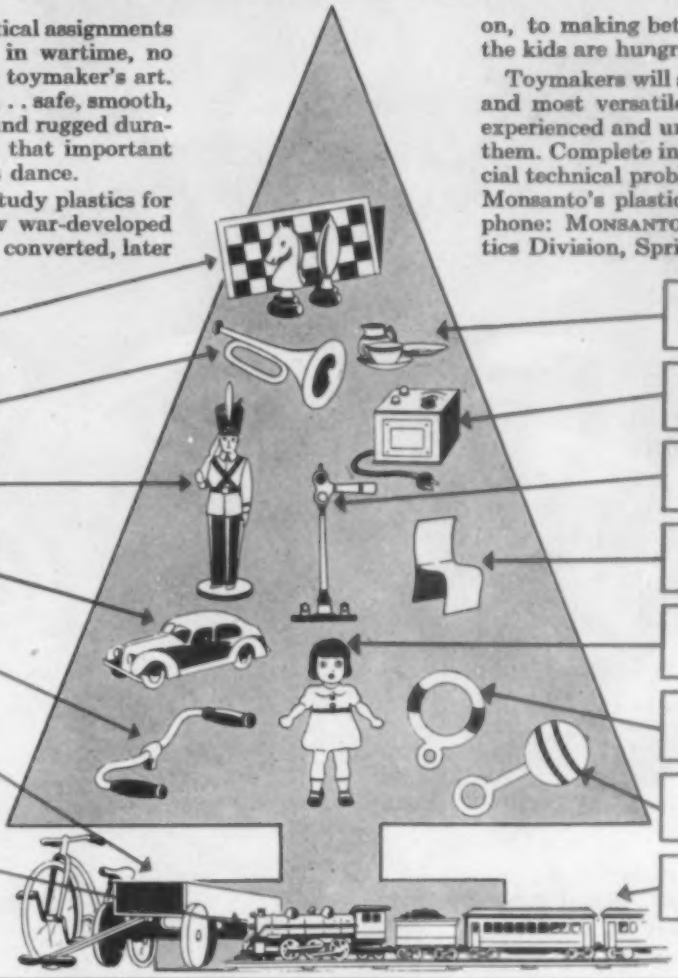
CLEVELAND OFFICE 326-7 PLYMOUTH BLDG., CLEVELAND 15, OHIO

HOW TO PUT THE MOST INTO POSTWAR TOYS OF PLASTIC

DESPITE the many grim and critical assignments that plastics have been given in wartime, no material is better suited to the toymaker's art. Plastics' bright, exciting colors . . . safe, smooth, sanitary surfaces . . . economy and rugged durability, all combine uniquely in that important business of making young eyes dance.

Right now is the time to re-study plastics for toys, to find out how the new war-developed qualities of plastics can best be converted, later on, to making better toys than ever, the kind the kids are hungry for.

Toymakers will secure from Monsanto a wide and most versatile group of plastics plus the experienced and unbiased advice that goes with them. Complete information, or answers to special technical problems may be had direct from Monsanto's plastic consultants. Write, wire or phone: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield, Massachusetts.



GAMES
Checkers, chess men, etc.—Molded Resinox, Lustron, Fibestos Boards

TOY MUSICAL INSTRUMENTS
Molded Lustron, Resinox, Fibestos

TOY SOLDIERS
Molded Fibestos, Lustron, Resinox

SMALL TOY VEHICLES
Molded Fibestos, Lustron, Resinox, Thalid Impression Moldings

ACCESSORIES
Handles, etc. — Molded Fibestos, Lustron, Resinox

WHEELED TOYS
Bodies, frames for wagons, scooters, etc.—Thalid Impression Moldings

ELECTRIC TRAINS
Locomotives, switch bases, control housings — Resinox
Underframe — Resinox (impact)

TOY DISHES
Molded Lustron, Resimene, Cerex

ELECTRICAL PARTS
Lustron, Resinox, Resimene

SIGNALS
Lustron, Fibestos

TOY FURNITURE
Thalid Impression Moldings

DOLLS
Fibestos (blown)

NURSERY TOYS
Teething Rings—Lustron, Fibestos

NOVELTIES
Rattles — Fibestos

CARS
Resinox, Resimene

MONSANTO PLASTICS FOR TOYS

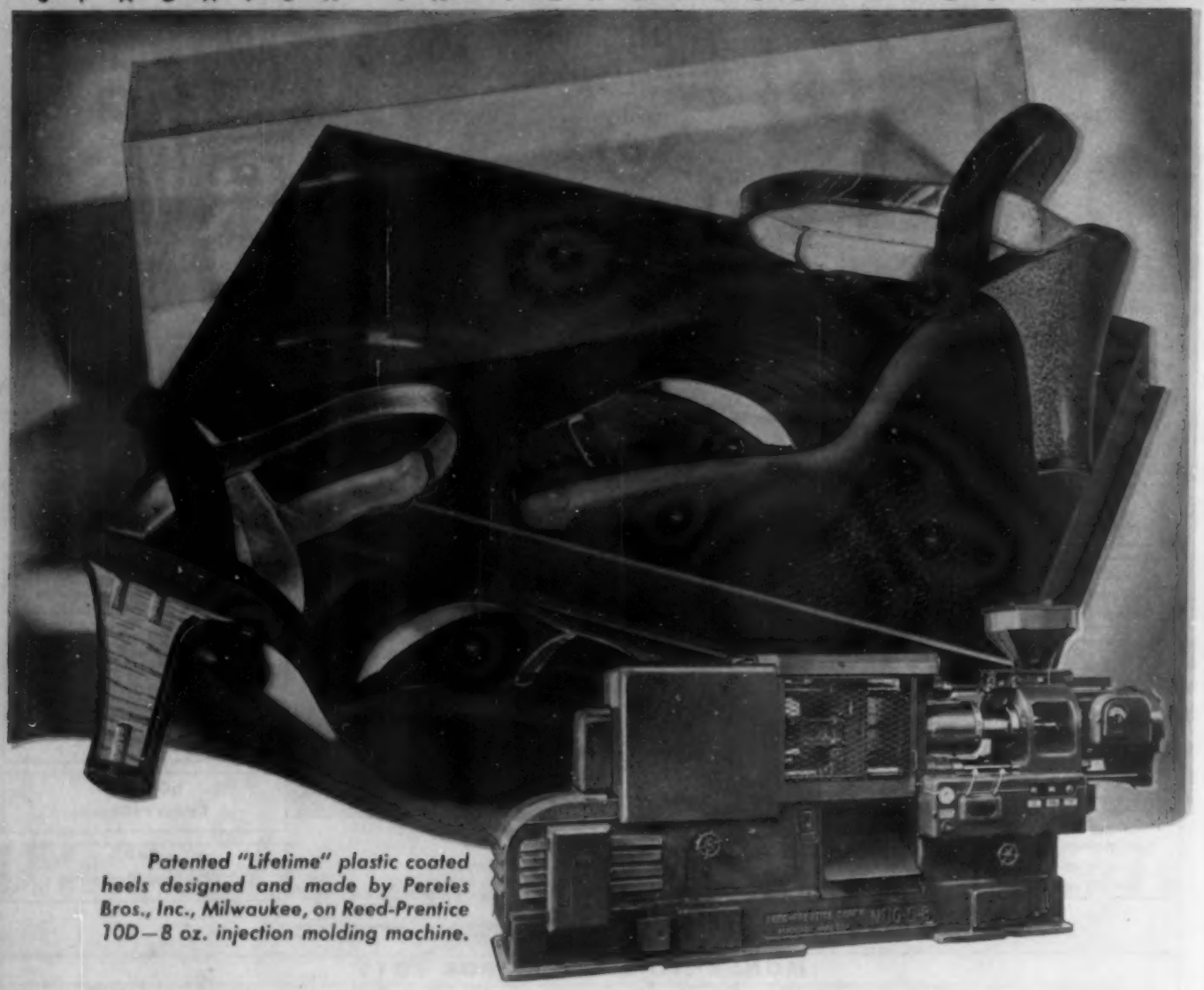
	Tensile Strength	Impact Resistance	Heat Resistance	Dimensional Stability	Color Range	Forms* Supplied	Molding** Methods
CEREX (heat-resistant thermoplastics)	good	good	to 230°F.	excellent	extensive	MC	I, C, E
FIBESTOS (cellulose acetates)	good to excellent	excellent	to 120—212°F.	fair to good	unlimited	MC, S, R, T	I, C, E
LUSTRON (polystyrene)	good	good	to 180°F.	excellent	unlimited	MC	I, C, E
NITRON (cellulose nitrates)	very good	excellent	to 140°F.	good	unlimited	S, R, T	Special methods
RESIMENE (melamine-formaldehydes)	very good to excellent	good	to 210—380°F.	excellent	all but lightest colors	MC, IR	C, T
RESINOX (phenol-formaldehydes)	good to very good	good to excellent	to 230—450°F.	excellent	darker colors only	MC, IR	C, T
VINYL ACETALS	rubber-like compounds are supplied in both thermoplastic and thermosetting (vulcanizable) forms, are used primarily as fabric coatings and adhesives but can also be extruded in limitless range of colors.						
THALID	Completely reactive thermosetting resin for impression molding. Impregnates glass cloth, other fabrics, or paper to make large, rigid panels or forms of high strength. (Ask for special bulletin on Thalid.)						

*MC—molding compounds S—sheets R—rods T—tubes IR—industrial resins
**I—injection C—compression E—extrusion T—transfer, form of compression

The broad and versatile family of Monsanto Plastics includes: Lustron polystyrenes Cerex heat resistant thermoplastics • Vinyl acetals • Nitron cellulose nitrates Fibestos cellulose acetates • Resinox phenolics • Thalid for impression molding Resimene melamines. Forms in which they are supplied include: Sheets • Rods Tubes • Molding Compounds • Industrial Resins • Coating Compounds Vuepak rigid, transparent packaging materials.

MONSANTO PLASTICS
SERVING INDUSTRY . . . WHICH SERVES MANKIND

• FASHION IN PLASTICS • • • STYLE •



Patented "Lifetime" plastic coated heels designed and made by Pereles Bros., Inc., Milwaukee, on Reed-Prentice 10D—8 oz. injection molding machine.

SURE-FOOTED FLATTERY

For down to earth style enchantment there is nothing like the new wooden core, plastic coated heels. The plastic is injection molded around the wooden cores under pressure so that it slightly impregnates the wood. Beside increasing the beauty of feminine footwear, this method of bonding gives a plastic surface that can be beautifully colored, of dull or shiny finish—not affected by the most severe weather conditions.

Reed-Prentice Engineered Service includes complete product analysis. This additional service is maintained to help you with your plastic production plans. The experience that made Reed-Prentice the largest selling line of plastic injection molding machines in America is available to help you with mold design and manufacture. Ask for information on machines available in 10D—6 oz. and 8 oz.; 10F—16 oz.; and 10H—22 oz. sizes.

INJECTION
REED-PRENTICE CORP.
WORCESTER MACHINES MASS., U.S.A.

NEW YORK OFFICE: 75 West St., New York 6, N. Y.
CLEVELAND OFFICE: 1213 W. 3rd. St., Cleveland 13, Ohio

LUMARITH* PLASTICS

present the case for beauty

THEY ARE INSPIRING new ideas in cosmetics container design . . . They are showing the way to more economical production . . . They are demonstrating how the inexpensive, expendable cosmetics container can be beautiful, smart and sales-appealing.

Lumarith is an old name in the cosmetics industry. Recently these versatile materials have served as alternates for war-scarce metals in many new applications. These newer roles are increasing as packaging stylists develop designs that take full advantage of Lumarith's unique characteristics of extreme lightness, superb color range, transparency and easy moldability.

The Lumarith molded container carries "lightly" in the handbag. Its chipproof surface actually improves with handling. The jade-like "feel" is inviting in all seasons.

Lumarith plastics are adaptable to high-speed, multiple-cavity injection molding. Molded surfaces require very little finishing and polishing. Intricate designs, raised or impressed lettering and close fitting threads are readily molded. The toughness of Lumarith provides strength without bulk and makes thin cross sections practical. You are invited to consult the technical staff of the pioneer plastics producers for specific information relating to your manufacturing problems. Celanese Plastics Corporation, *a division of Celanese Corporation of America*, 180 Madison Avenue, New York 16, N.Y.

A Celanese Plastic*

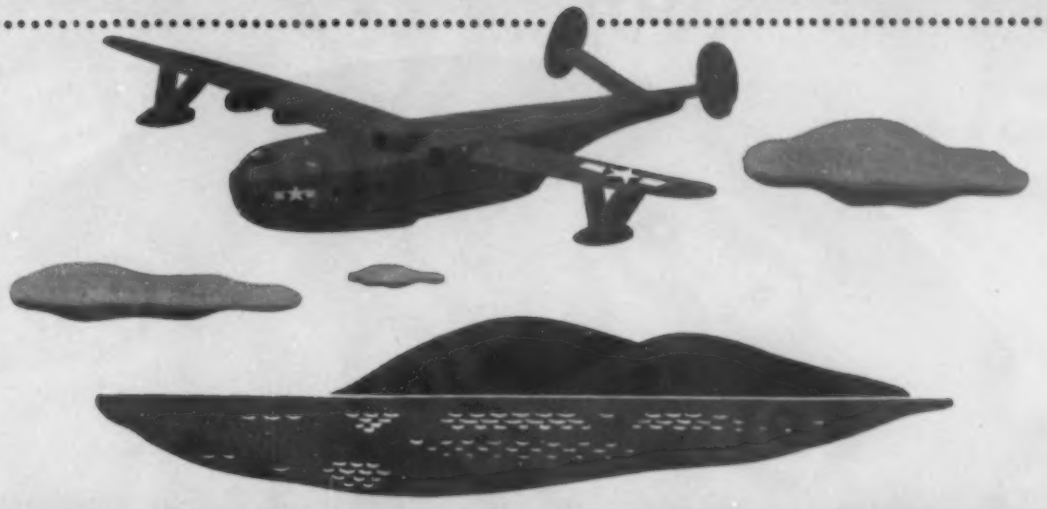
*Reg. U. S. Pat. Off.

HOCUS-PLASTIC

One word
is in danger
of becoming
the postwar synonym
for "abracadabra".
The word is
"plastics".
True, many of the possibilities
of plastics
are nothing short of magical;
yet plastics are not voodoo . . .
and can be hoodoo
for the uninformed.
Get all the facts,
both good and bad,
from our unprejudiced
record of experience.

HAVE YOU A PLASTICS PROBLEM?

PROLON PLASTICS



Whether you build Bombers or Trucks . . .

.....your product can be improved with a Kimpreg* Surface

A revolutionary new alloy-like material is achieved by fusing to plywood's surface a cured plastic skin of KIMPREG. This resultant material is not a plywood in the ordinary sense, not a conventional plastic laminate. It is a brand new, better structural medium with countless applications in many products—including, very probably, those *you* plan for post-war production.

With KIMPREG, plywood is converted into an improved substance which can be machined, formed and fastened like ordinary wood—yet has a plastic's smooth, tough surface and beautiful, permanent, paintless finish.

KIMPREG adds the following advantages to plywood: 1) increases durability and flexural strength; 2) provides resistance to moisture and vapor; 3) armor-plates against extreme abrasion; 4) prevents surface checks; 5) diminishes grain-raising effects; 6) makes the material scuffproof, splinterproof, snag-resistant; 7) affords a stainproof, washable, "wipe clean" surface; 8) creates resistance to chemical action, decay, temperature-extremes, fire, vermin, and mold. Moreover, it is warm to the touch, does not have the chill "feel" of metal surfaces.

Today all KIMPREG is required for military needs, ranging from airborne "prefab" huts to glass-smooth tables for packing parachutes without snagging. Hence, the wartime color of KIMPREG is a soldierly olive-drab. Post-war, however, it will be offered in a variety of appealing hues.

Now is the time to investigate the possibilities of KIMPREG-surfaced materials for your *peacetime* requirements.

*TRADE MARK

Kimpreg
TRADE MARK

A PRODUCT OF Kimberly Clark RESEARCH

Among the users of KIMPREG are: Buffelen Lumber & Manufacturing Company; Olympic Plywood Company; Washington Veneer Company; and The Wheeler, Osgood Company; all of whom are currently producing a Douglas Fir Plywood surfaced with KIMPREG. This product is sold under the trade name of Indoron.

Send Coupon for FREE KIMPREG Book to:
Kimberly-Clark Corporation, Neenah, Wis.
MP-445

Name _____

Firm _____

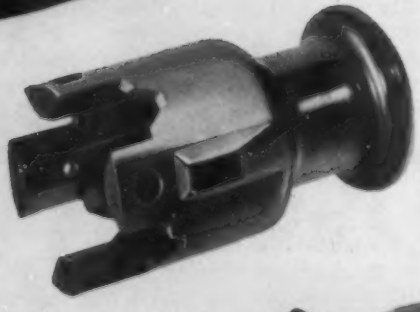
Type of Business _____

Address _____

City _____ State _____

Plastic Problems Cheerfully Solved

Since 1897, Stokes has been molding plastic and hard rubber products with built-in quality and durability. This half century of experience is at your disposal in solving your plastic and hard rubber problems. Our research staff, supported by our extensive manufacturing facilities, invites your inquiry.

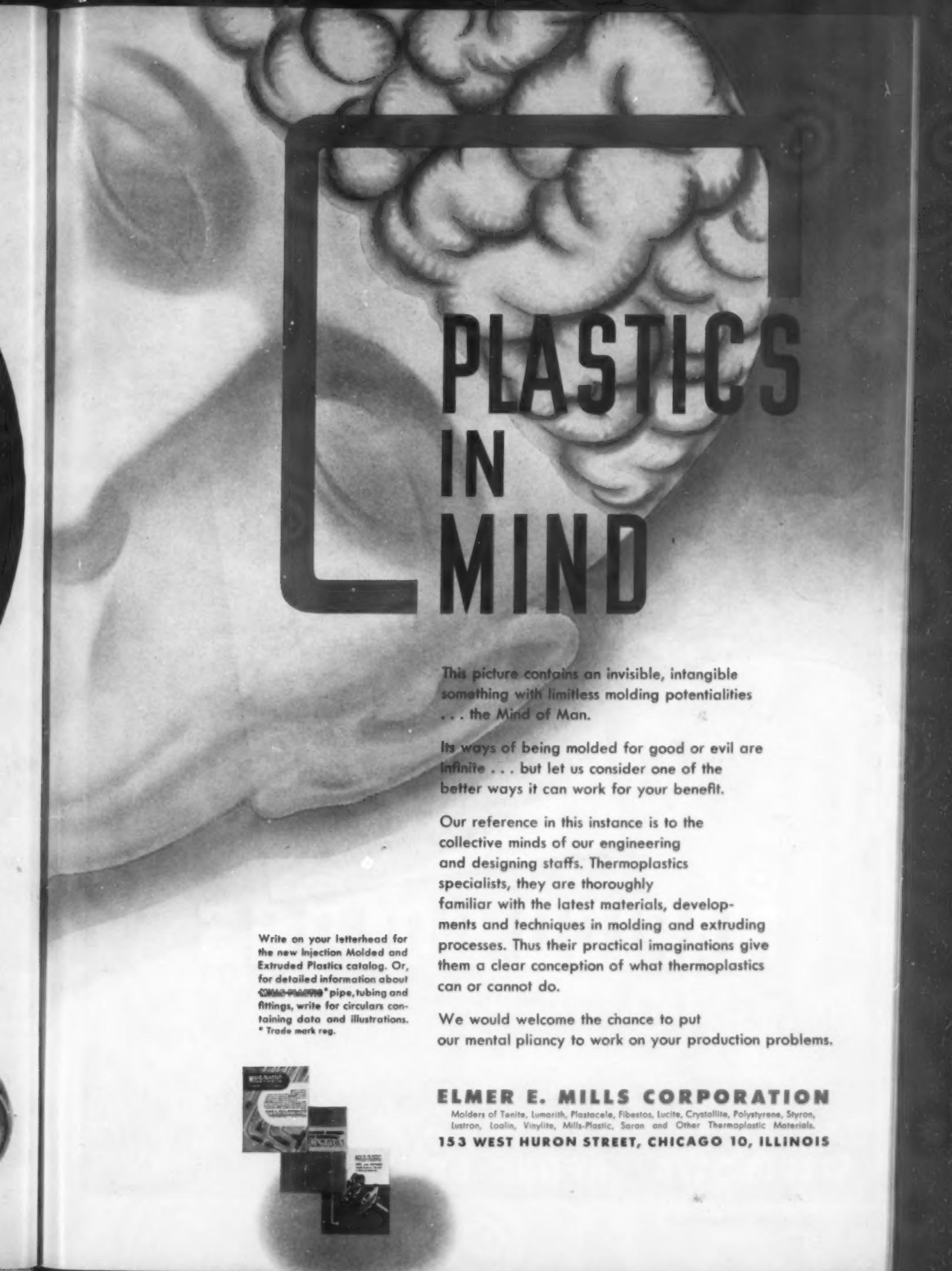


JOS. **STOKES RUBBER** CO.

Molders of Hard Rubber and Plastics • ***Since 1897***

TRENTON, N. J.

In Canada: Jos. **STOKES RUBBER** Co., Ltd., WELLAND, ONT.



This picture contains an invisible, intangible something with limitless molding potentialities . . . the Mind of Man.

Its ways of being molded for good or evil are infinite . . . but let us consider one of the better ways it can work for your benefit.

Our reference in this instance is to the collective minds of our engineering and designing staffs. Thermoplastics specialists, they are thoroughly familiar with the latest materials, developments and techniques in molding and extruding processes. Thus their practical imaginations give them a clear conception of what thermoplastics can or cannot do.

We would welcome the chance to put our mental pliancy to work on your production problems.

Write on your letterhead for the new Injection Molded and Extruded Plastics catalog. Or, for detailed information about [redacted]* pipe, tubing and fittings, write for circulars containing data and illustrations.
* Trade mark reg.

ELMER E. MILLS CORPORATION

Molders of Tenite, Lumarith, Plastacele, Fibestos, Lucite, Crystallite, Polystyrene, Styron, Lustron, Loalin, Vinylite, Mills-Plastic, Saran and Other Thermoplastic Materials.

153 WEST HURON STREET, CHICAGO 10, ILLINOIS

LIGHT-FAST Colors FOR PLASTICS

- NON-TOXIC
- ACID AND ALKALI RESISTANT
- HIGH TINTING STRENGTH
- NON-BLEEDING
- FINE PARTICLE SIZE

Where freedom from fading and color change are important in the coloring of plastics, MAPICO pigments may be depended upon.

This is equally true of the mass colors and of the wide range of pleasing tints derived from them.

Mass reds are deep and rich in tone and yield many beautiful tints of orchid, coral and pink.

From the yellows and browns desirable creams, tans and buffs may be obtained in great variety.

MAPICO COLORS

Pure Precipitated Oxides of Iron Produced Under Rigid Chemical Control

COLUMBIAN COLLOIDS

400 TONS OF SMOKE A DAY

Do you wish technical cooperation?

COLUMBIAN CARBON CO. • BINNEY & SMITH CO.

MANUFACTURER DISTRIBUTOR

YELLOWS • REDS • BROWNS • BLACK

Are you sniffing around for a better product?

(Can you name the plastic parts that make up this "dog"? See chart below.)

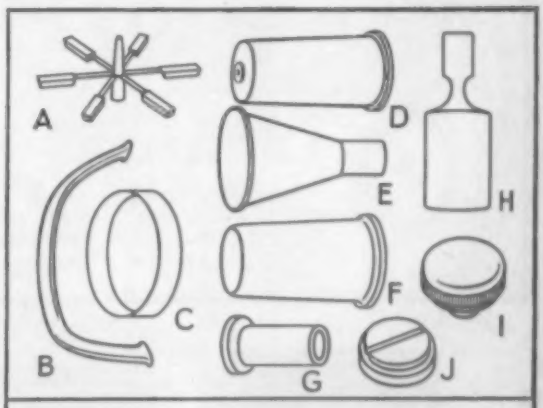
Call this pooch unusual? He's nothing compared with Continental's Plastics Division.

Today, when selecting the right plastic means so much to a product, our designers, engineers and research men have produced many unusual things. Plastic parts for swivels and syringes, cogs and combs and cutlery, plane parts and pumps—these and a lot more, planned and turned out by men who know their business.

Our long years of experience in the plastics field plus the best facilities you'll find anywhere add up to the solution to any manufacturer's problem of improving an old product or introducing a new one.

So count on Continental to suggest the exact plastic features your product should have. You'll find an alert, progressive organization ready to give sound, practical advice and assistance at all times.

Tune in "REPORT TO THE NATION," every Saturday over CBS coast-to-coast network



(a) Drawer pulls—injection; (b) Air scoop mounting—compression; (c) Globe base—injection; (d) Sales ticket-holder—compression; (e) Funnel—compression; (f) Shell for vaporizer—compression; (g) Bushing—compression; (h) Hairbrush handle—injection; (i) Gearshift ball—compression; (j) Brush cap for motor—compression.

CONTINENTAL CAN COMPANY, INC.

PLASTICS DIVISION

HEADQUARTERS: Cambridge, Ohio

Sales Representatives in all Principal Cities

COMPRESSION • INJECTION • EXTRUSION
SHEET FORMING • LAMINATION

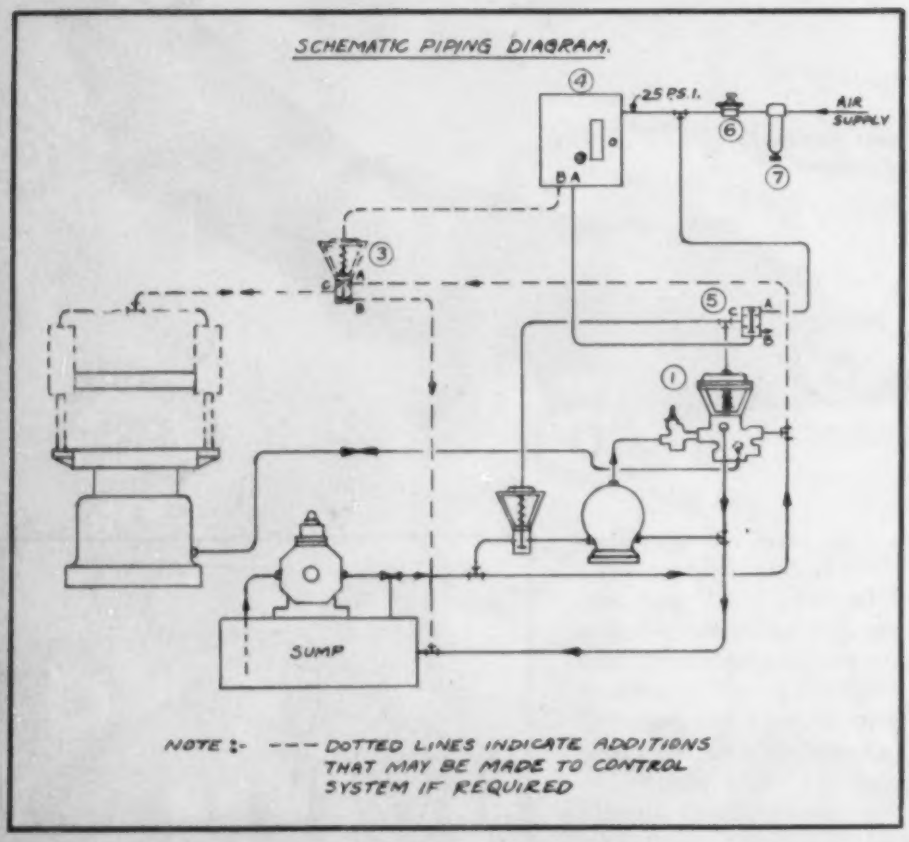
Other products of Continental Can Company: Metal cans for food and other products; fiber and paper containers; crown caps and cork products; machinery and equipment. Special war cans and weapons.

FEEL NERVOUS

about compression molding?

We don't blame you for feeling jittery about compression molding. There are too darn many things to keep your eye on all at once. So why not let us work out a set-up with the Taylor Flex-O-Timer that will do the whole job *automatically* and *accurately?* Sure, it's complicated, but *we do it!* All you have to do is load the press and push the button!

DO IT AUTOMATICALLY WITH A TAYLOR FLEX-O-TIMER

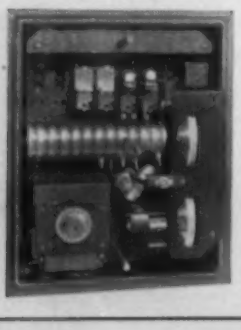

SCHEMATIC PIPING DIAGRAM.
25 P.S.I.
AIR SUPPLY
SUMP
NOTE :- --- DOTTED LINES INDICATE ADDITIONS THAT MAY BE MADE TO CONTROL SYSTEM IF REQUIRED

THE Flex-O-Timer gives you precise, accurate control of *all* steps in the molding operation, which means maximum production of uniformly high quality products. The set-up in the diagram at left performs the following functions:

1. **Closes press on low pressure**
2. **Applies high pressure automatically**
3. **Provides for bumping or gassing**
4. **Molds**
5. **Opens press**
6. **Operates "pull backs" or "push downs"** (*optional according to type of press.*)

Once you've determined your ideal molding schedule, the Flex-O-Timer can reproduce it *exactly* time and time again. If you want to increase or decrease the molding period, all you have to do is make a simple dial adjustment in the Auxiliary Timer (built inside the Flex-O-Timer case) without disturbing any of your main settings.

Whatever your plastics molding problem, Taylor can work out a set-up that will do the whole job automatically. Ask your Taylor Field Engineer! Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada. *Instruments for indicating, recording, and controlling temperature, pressure, humidity, flow and liquid level.*



ARMY NAVY

Taylor Instruments

MEAN

ACCURACY FIRST

IN HOME AND INDUSTRY

BUY MORE WAR BONDS—AND KEEP 'EM!

● Its *bend-ability* and high arc resistance, suggested the use of National Vulcanized Fibre in the manufacture of this arc baffle used in an electric circuit breaker.

Tough Production Problems Made Easy by this Remarkable Property of *National Vulcanized Fibre*

Just as the amazing bending properties of National Vulcanized Fibre suggested its use and simplified the production of this arc baffle—so will its combination of outstanding characteristics make it readily adaptable for the manufacture of countless other industrial products.

Its superior machinability and forming qualities, its toughness and high dielectric strength, its resistance to wear and abrasion, its lightness of weight and its long-lasting durability . . . all combine to make this material highly versatile and suitable for an almost endless number of industrial uses. If desired, these same properties may be modified to meet requirements of your specific applications.

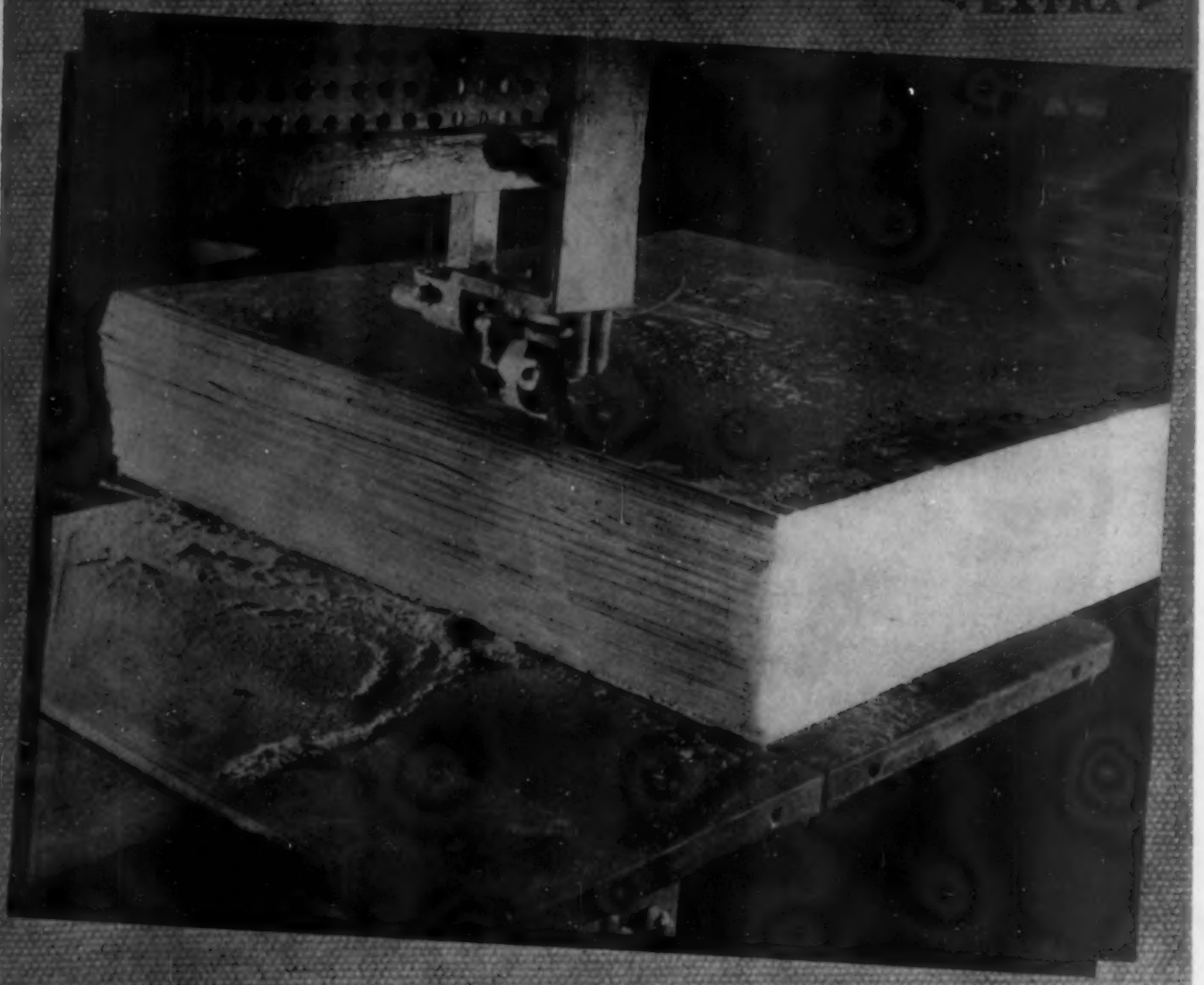
Right now our entire output is being used for vital war purposes. But our technical engineers will be glad to work with you and show you how this versatile material will help you overcome tough production problems in peacetime . . . how it may open up entirely new fields for profitable products for you. Write us *now*. Let a trained technical man show you how National Vulcanized Fibre will help you *later on*.

NATIONAL VULCANIZED FIBRE CO.

Wilmington, Delaware *Offices in Principal Cities*

ASSOCIATED WITH UNIFORM QUALITY FOR OVER HALF A CENTURY

MT. VERNON EXTRA



"X" Is a Known Quantity in Mt. Vernon Extra

Fabric uniformity is such a vital factor in the production of successful laminates that you can not allow it to be an unknown quantity. A broad system of laboratory control guides every step in the manufacturing of MT. VERNON Extra fabrics. This assures a degree of uniformity which permits deep and complete penetration of whatever resins may be employed. You will find it to your advantage to specify MT. VERNON Extra.

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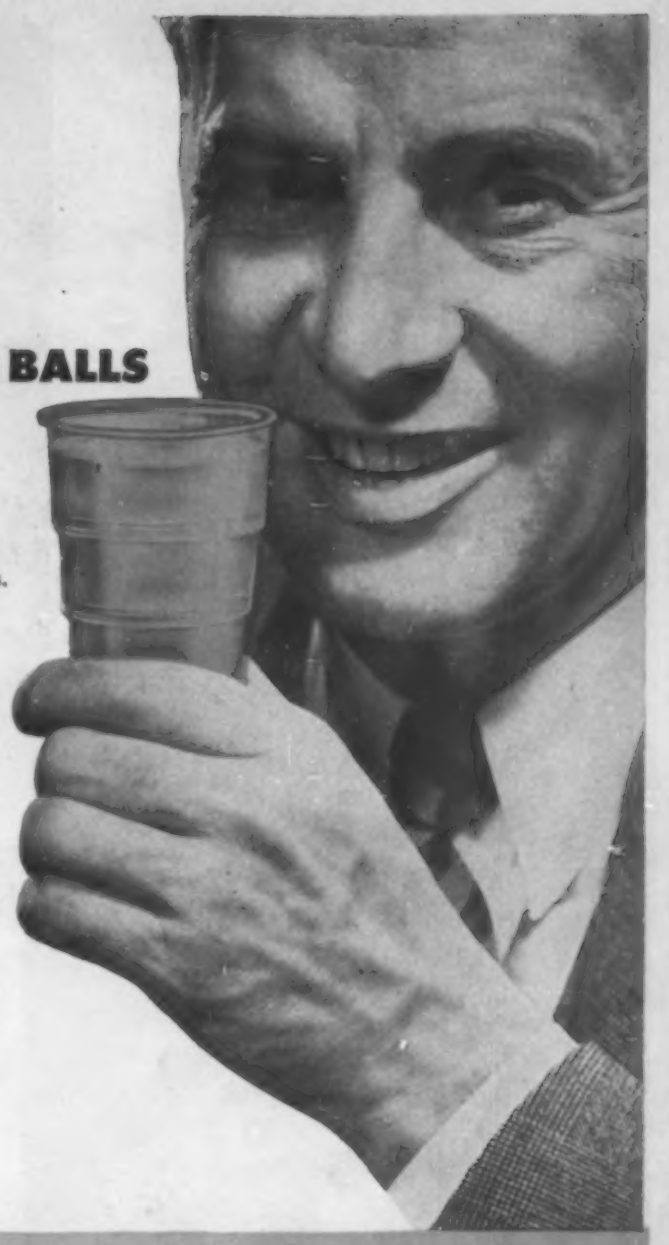
Here's Success

—FOR CUPS OR CLOSURES
—PACKAGES OR PING PONG BALLS



Where plastic items are produced in hundreds of thousands, the cellulosic plastics almost invariably are first choice . . . because they provide *more* useful properties than any other materials.

Take this collapsible, cellulose acetate drinking cup—produced by Wecolite Company, New York. It weighs but two ounces. Is tough enough to take severe shocks. Water cannot harm its lustrous finish. Transparency enables it to serve as a measuring cup.

And cellulose acetate cuts costs to the bone—through high-speed injection molding. Ten pieces, or two complete cups, are formed completely and ready for assembly in a few seconds.

Hercules does not make plastics, but supplies the high-quality cellulose derivatives from which they are made. For data, write Cellulose Products, Dept. MP.

HERCULES POWDER COMPANY
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HERCULES
CELLULOSE ACETATE
CELLULOSE NITRATE
ETHYL CELLULOSE

The general-purpose production plastics

Only the cellulosics offer this wide combination of properties

TOUGHNESS . . . Even terrific drop hammer blows cannot shatter metal-shaping dies cast from ethyl cellulose.

COLORABILITY . . . Pastels, opaques, transparents, translucents, whites, ivories, pearls . . . high luster and eye-appeal.

ODORLESS, tasteless, cellulose acetate or ethyl cellulose meets a thousand packaging needs.

LIGHT WEIGHT, high impact resistance, resiliency permit thinner wall sections than with any other plastics.

LOW COST keeps production expenses down; profits up. Low specific gravity, thinner wall construction possible, gives more pieces per pound.

NO WASTE . . . Every bit of scrap in molding, extrusion, other forming operations, can be reclaimed and re-used. No chemical change takes place.

EASILY FABRICATED . . . Can be injection or compression molded, extruded, drawn, swaged, blown, easily machined with standard tools.

RIGID OR FLEXIBLE as desired . . . flexibility for movie film or tubing . . . rigidity for billiard balls or hardware.

ELECTRICAL PROPERTIES meet many exacting requirements . . . for magnet coils, wire insulation, electrical housings.

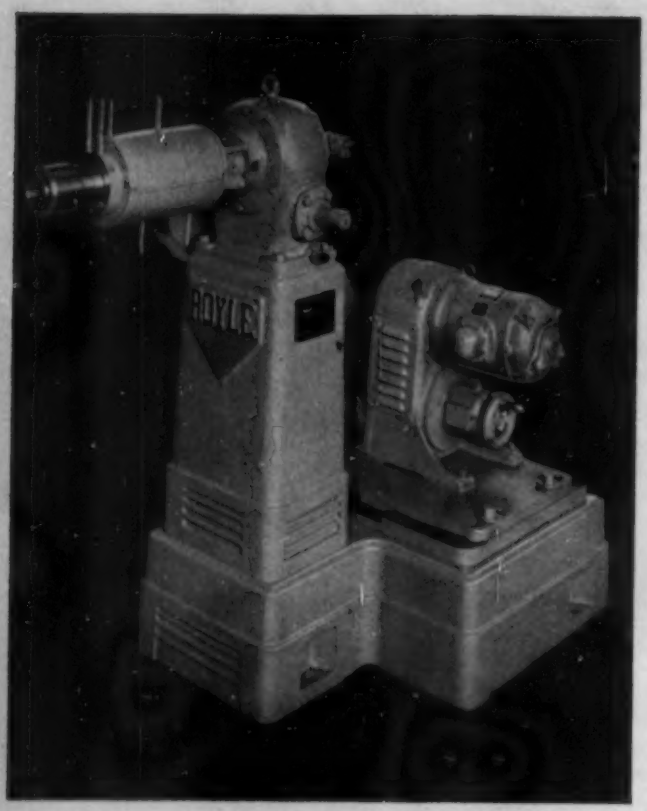
CRYSTAL CLARITY . . . X-ray film, aircraft cowlings, watch crystals, demonstrate water-white transparency.

STABILITY . . . Collectively the cellulosics are stable in form and finish over a wide and useful range of exposures to moisture, solvents, acids, alkalies.

GP-324

Designed For Experimental and Product Extruding

Royle No. 1



Royle No. ½

● Rugged is the word to describe these compact and highly efficient Royle Continuous Extruding Machines—the No. ½ and No. 1. Their diminutive size embraces all of the characteristics required for larger and heavier extruding processes.

● Primarily designed to become an integral part of laboratory equipment—the technician can be sure that his experiments will have true relation to actual product extruding—these machines are economical and efficient producers of such products as tubes, rods, fine wire insulation, mono-filament and thread coating.

● Except for dimensional differences these machines possess identical characteristics.

JOHN ROYLE & SONS

ROYLE
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PIONEER BUILDERS OF EXTRUSION MACHINES SINCE 1880

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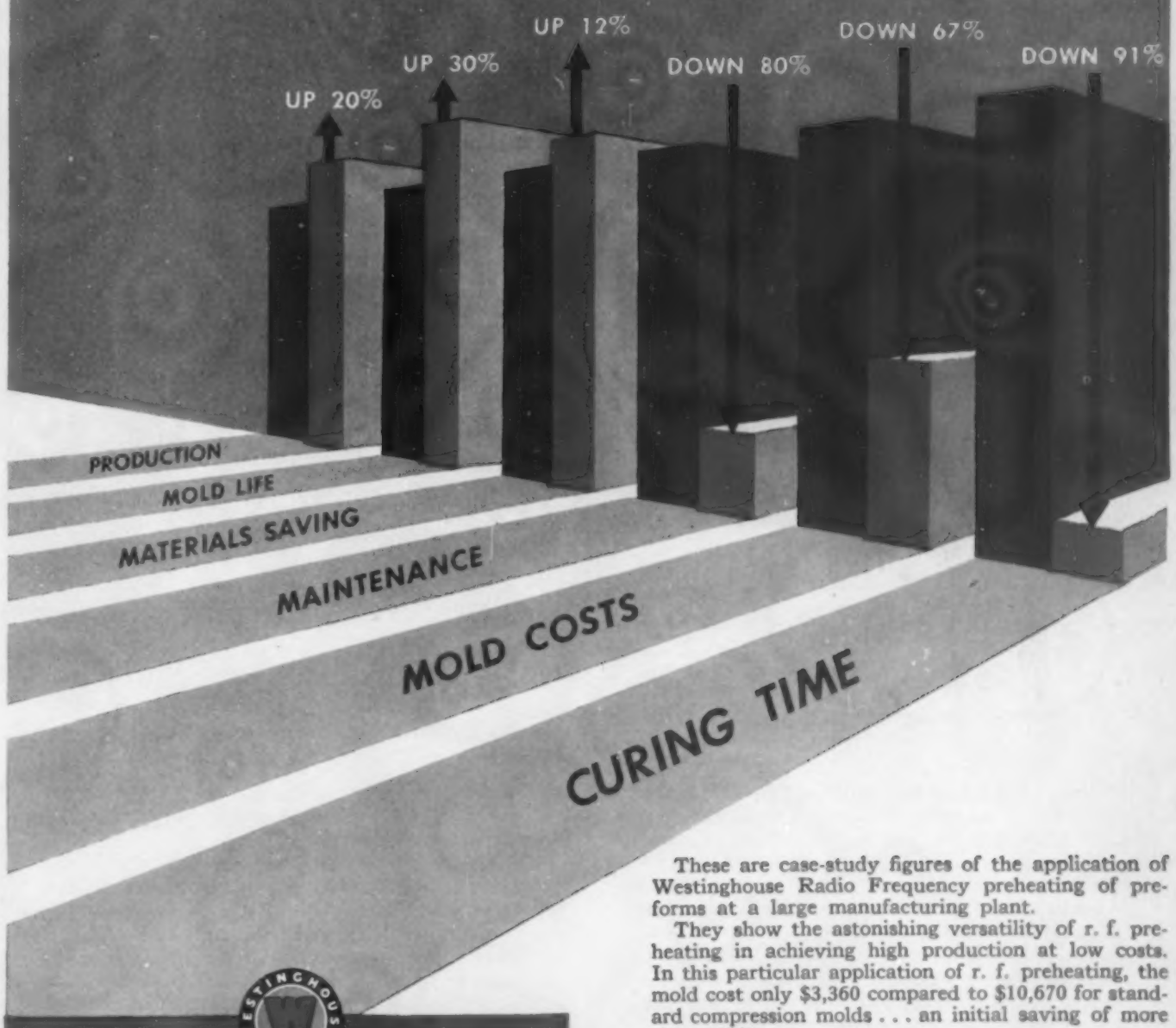
University 3726

PATERSON 3, NEW JERSEY

here's what radio frequency preheating can do in **molding plastics**



These are case-study figures of the application of Westinghouse Radio Frequency preheating of preforms at a large manufacturing plant.

They show the astonishing versatility of r. f. preheating in achieving high production at low costs. In this particular application of r. f. preheating, the mold cost only $3,360 compared to $10,670 for standard compression molds . . . an initial saving of more than 66%!

The bar chart above illustrates how such exceptional savings apply in every phase of r. f. preheating. And the flexibility of r. f. preheating adapts it perfectly to many operations . . . it is ideal for making parts with long, slender holes because the reduced pressure does not bend or break mold pins. Metal inserts can be molded better by the r. f. technique.

Standard ratings are available from 1 to 20 kw, and up to 200 kw if your application requires this power. You can learn more about Radio Frequency preheating and its applications to your molding by writing your nearest Westinghouse office. Or write Westinghouse Electric & Manufacturing Company, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-08100

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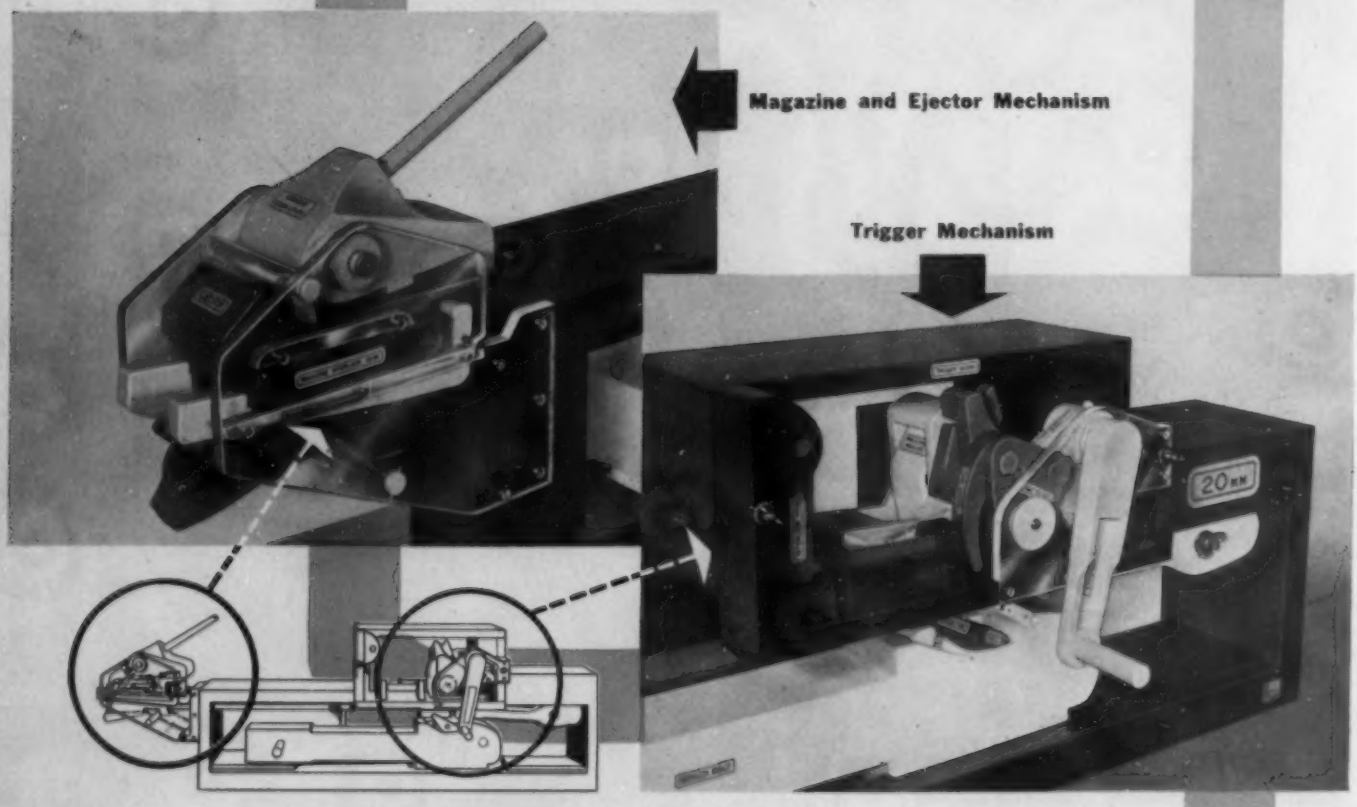
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Electronics at Work

Custom Molding

by ERIE RESISTOR

Solves Multiple Problems



IF you have a plastics molding problem, place it in the hands of specialists. Erie Resistor, pioneer custom injection molder of America, has the experience and facilities to meet your most exacting specifications. An interesting example is the "twice size" model of the 20 millimeter Naval instruction gun shown in illustration.

Selection of proper molding materials, correct die design, expert molding technique, and adequate finishing facilities, were factors of prime importance in its production.

An intricate coring job was involved. Light weight, combined with high impact strength, were important requisites because of frequent and inexperienced handling. Dimensional stability was very essential since dismantling and reassembling is practically a continuous procedure and parts must fit accurately to insure proper operation.

The use of plastics also permitted the use of a functional color that will not wear off with repeated handling.

Yes, a multiplicity of problems were solved by Erie Resistor Engineers in making this training gun of plastics. It exemplifies only one of the hundreds of custom molded plastic articles turned out by the Plastics Division of Erie Resistor, where sound engineering, experienced molding technique, and adequate facilities are available. Our new illustrated bulletin describes our facilities and background in detail. A letter to us will bring a copy to you.

Plastics Division

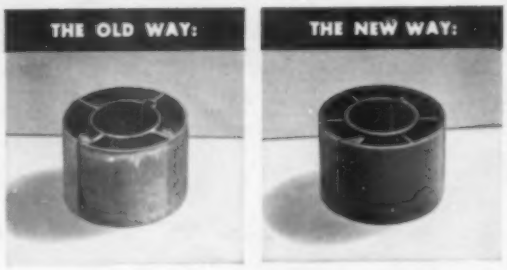
ERIE RESISTOR CORP., ERIE, PA.

LONDON, ENGLAND • • TORONTO, CANADA

★ ★ ★ Do More Than Before—Buy EXTRA War Bonds ★ ★ ★

FILM CORES OF "PLASTACELE"

Cost less... weigh less... maintain dimensional stability

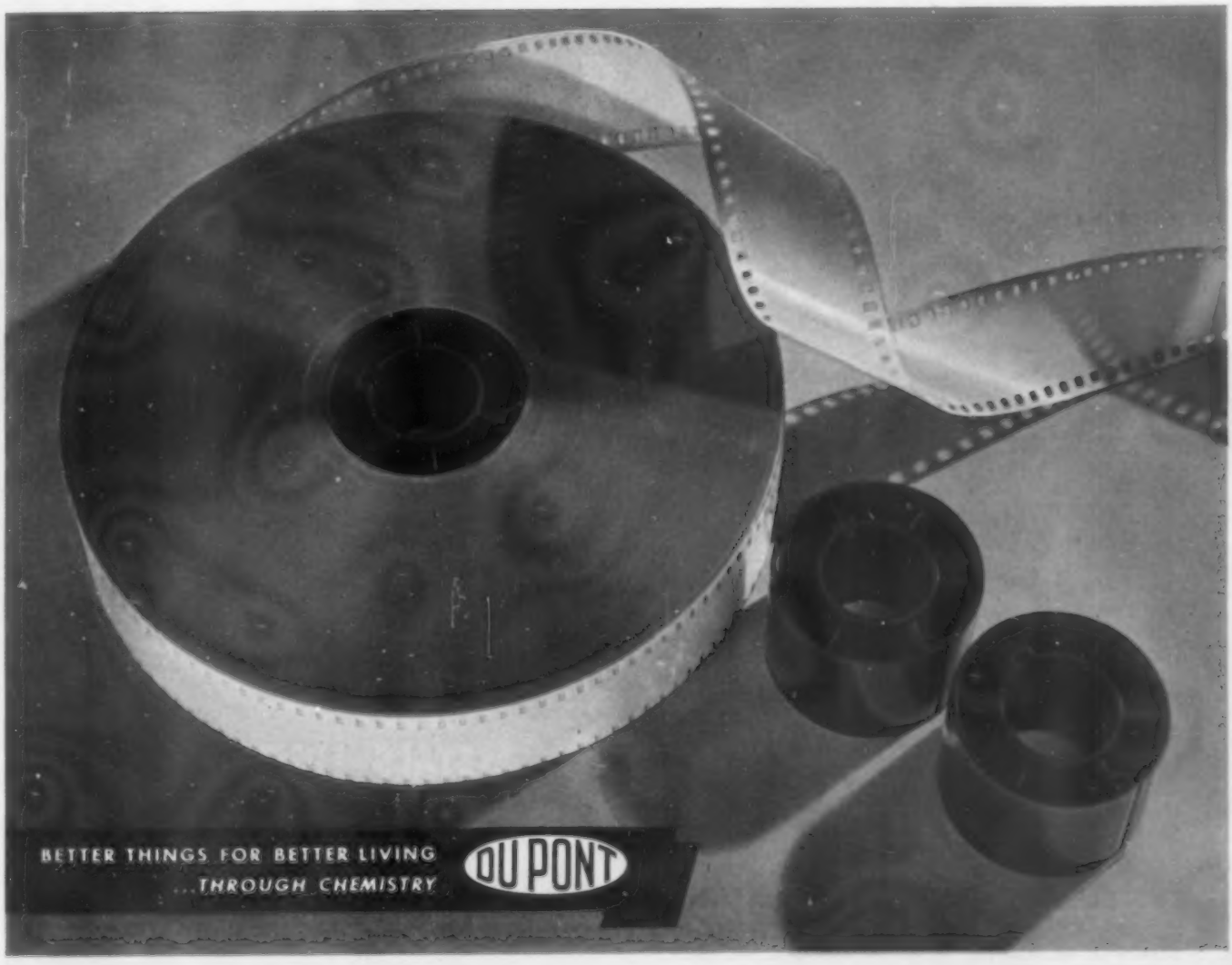


The old way: Metal core weighed 81.5 grams.
The new way: Core of Du Pont "Plastacele" weighs 27.0 grams. Molded for the Du Pont Photo Products Department, Wilmington 98, Del., by A. L. Hyde, Grenloch, New Jersey.

FOR PLASTICS CONSULT DU PONT

ADVANTAGES: These film cores of "Plastacele" cellulose acetate plastic have shown that they possess exceptional dimensional stability. In addition, they cost less, are lighter in weight, and will not corrode. Today these cores, which are designed to hold up to 2,000 feet of motion-picture film in 16 mm., 32 mm., and 35 mm. sizes, are made in green (to identify negative film) and brown (to identify positive film). Six cores are injection-molded at one "shot" for each 30-second cycle. Unlike some other plastics considered, "Plastacele" does not attack or fog the film. Because they do not bend out of shape, the plastic cores do not throw the film out of line if they happen to become damaged in use or in transit.

AVAILABILITY: Du Pont "Plastacele" is under WPB allocation. For information or experimental quantities write: E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, New Jersey.



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Beauty AND Utility

IN PLASTICS AND METALS

Tire valve caps of flexing plastic made to seal original valve stems or stems that have had long wear.

Flexing plastic nipple for coil and wire connections. Tight, serviceable —a 100% war development.

Distributor cap, with metal insert, of advanced engineering design.

Enamel filled metal bicycle plate and plastic bicycle reflector.

Trim of outstanding beauty is made from combination of metal and plastic. An unusual product.

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Decorative
METALS and PLASTICS

Look to Auto-Lite for versatility and craftsmanship in plastic, metals and combinations of both. Here at the Bay Manufacturing Division's big plant you'll find the processes, the materials, the know-how you need to add Beauty and Utility to your product. And in tomorrow's competitive market, Beauty and Utility may be the essential ingredients that spell increased sales volume for your business. Find out now what Auto-Lite can do for you by writing to

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Tune in AUTO-LITE'S GREAT RADIO SHOW "EVERYTHING FOR THE BOYS"—Starring Dick Haymes with Gordon Jenkins' Orchestra—Every Tuesday night—NBC Network

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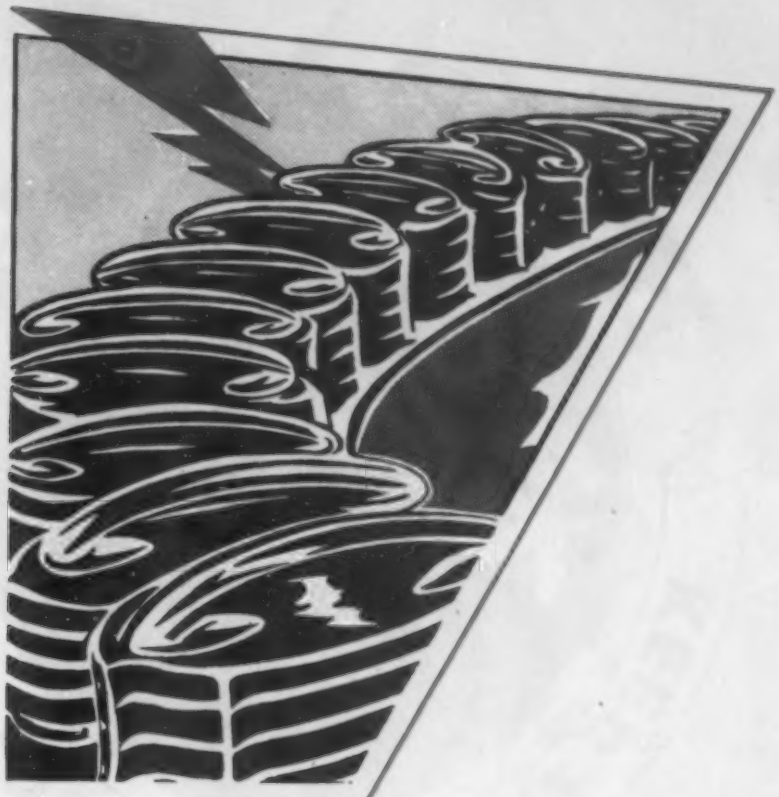

PRODUCTION

Our plant facilities are extensive and ideally set up for the production of moldings in large quantities to meet our customers' production schedules. From design to delivery, every operation is under our complete control. We make our own molds and do our own machining of finished parts. Please feel free to consult our Planning Division in regard to your requirements for plastics moldings . . . either immediate or postwar.

UNIVERSAL

PLASTICS CORPORATION

NEW BRUNSWICK · NEW JERSEY

Main Office	270 Madison Avenue, New York 16, New York
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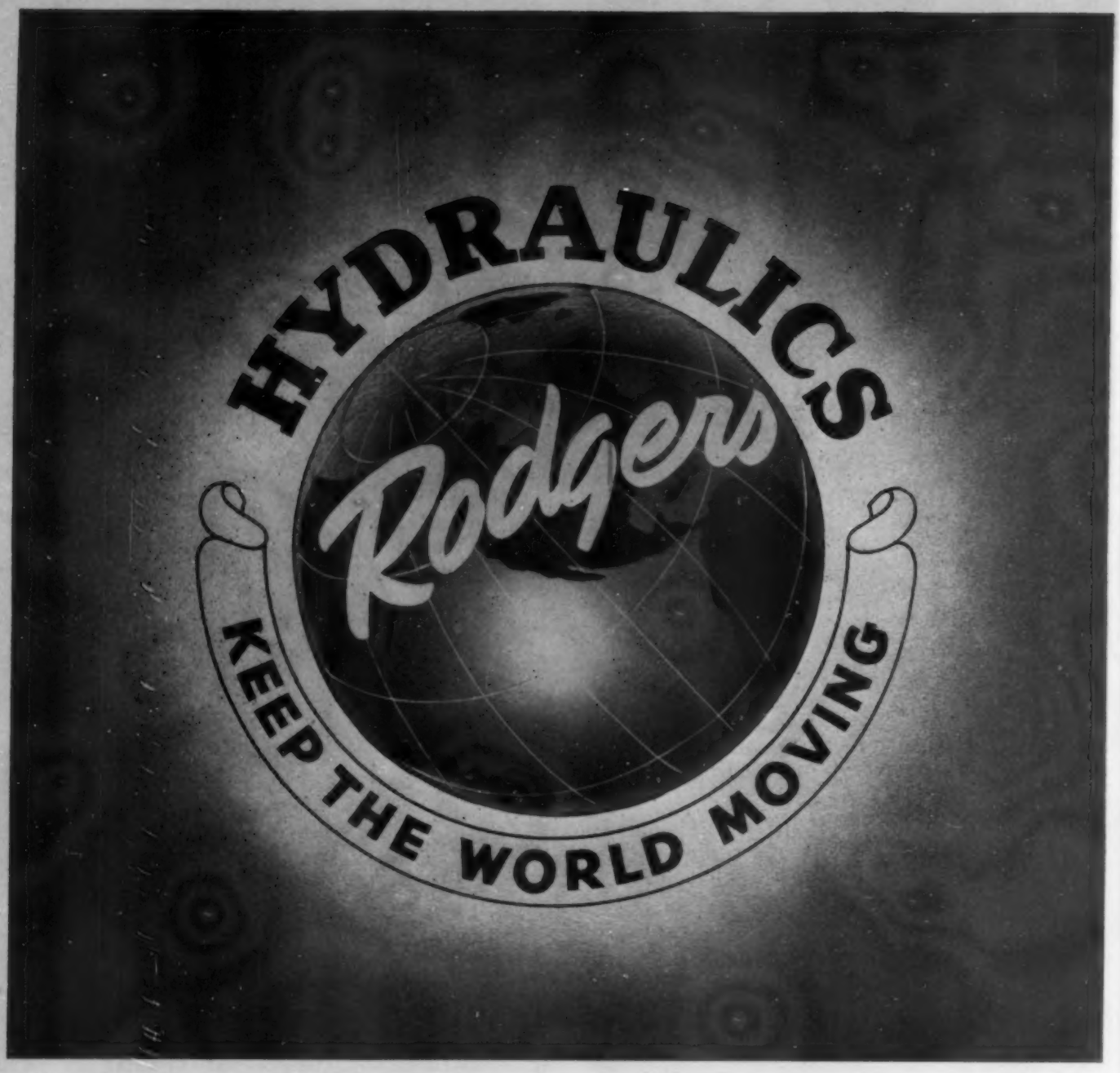
Paragon Sales Company, Inc. . . .	111 South Street, Philadelphia, Pennsylvania
June & Company	719 New Center Building, Detroit 1, Michigan



The day is not too far away when we can again make available to the Plastics Industry improvements in methods and equipment for plastic molding. Until that day we shall continue without delay the production of war essentials.

Remember "Rodgers for Results"

RODGERS HYDRAULIC, Inc.

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Manufacturers of

Universal Hydraulic Presses • Hydraulic Plastic Presses • Track Presses • Hydraulic Keel Benders
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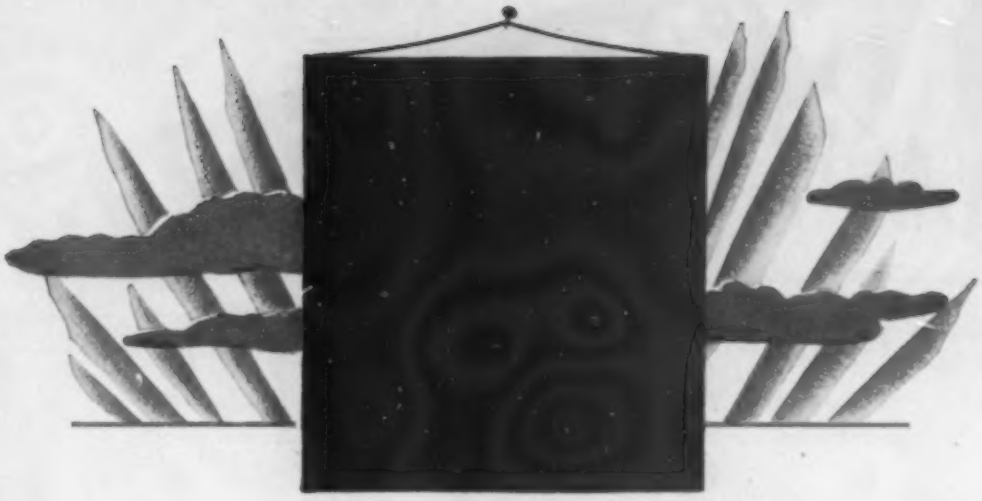

Sunrise Behind the Plastic Blackout

So MANY advances in plastics are military secrets that civilians hardly realize how brightly the sun of plastics' progress shines behind the blackout. Although most of our plastics production has been concentrated in producing closures for containers used on every war and home front, we have naturally played our part in many plastics developments. If your post-war plans indicate the possibility of using plastics, especially in combination with glass containers, we suggest that you write us.

CLOSURE AND PLASTICS DIVISION
OWENS-ILLINOIS GLASS COMPANY
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Branches in all Principal Cities

BAKER PLASTICIZERS

are designed especially for the following resins:

1. Vinyl Resins
2. Phenolic Resins
3. Melamine Resins
4. Cellulose Resins
5. Urea-Formaldehyde Resins
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Baker Plasticizers Contain No Phthalate

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Crystal clarity, *plus* chemical resistance ...*in* Plexiglas

PLEXIGLAS valve parts used in the Chem-O-Feeder, designed and built by Proportioneers, Inc., to supply accurately measured quantities of water-treating chemicals to a stream of liquid. Parts are injection molded (by Firestone Rubber & Latex Products Company, Fall River, Mass.) in a single-step operation — molded to final shape and dimensions without subsequent machining.

These outstanding features are among the reasons why Proportioneers, Inc., selected PLEXIGLAS for the valve parts on its widely used chemical feeder:

Resistance to chemicals, especially the solutions used in water treatment.

Lasting transparency, to permit quick visual inspection.

Ease of molding into *finished* parts, complete with assembly threads and flanges.

Dimensional stability and low water absorption.

Add to these advantages such other features as light weight, high impact strength, resistance to weathering, permanent electrical properties...and you may see many ways in which "Aviation's Standard Transparent Plastic" will fit into your own war production — or post-war plans.

For technical assistance in using PLEXIGLAS to best advantage, call our nearest office: Philadelphia, Los Angeles, Detroit, Chicago, Cleveland, New York. Canadian Distributor: Hobbs Glass Ltd., Montreal.

9 awards to Rohm & Haas Company and its associated firms, The Resinous Products & Chemical Company and Charles Lennig & Company.

Only Rohm & Haas makes

PLEXIGLAS

CRYSTAL-CLEAR ACRYLIC SHEETS, RODS AND MOLDING POWDERS

PLEXIGLAS is the trade-mark, Reg. U. S. Pat. Off., for the acrylic resin thermoplastic sheets, rods and molding powders manufactured by Rohm & Haas Company.

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ST. LOUIS PLASTIC
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ALCOA FOIL and PLASTICS
SEAL THESE PACKAGES...
LEMON JUICE POWDER
SYNTHETIC
VITAMIN C POTENCY
60 MILLIGRAMS
Ingredients: Dried Pure Lemon Juice with Corn Syrup, Citric Acid, Dextrose, Ascorbic Acid (Vitamin C), Lemon Oil and Tricalcium Phosphate.
DIRECTIONS ON OTHER SIDE

Fruit powder packets carried in Army field rations are another example of the way aluminum and plastics can combine to do a better job.

Millions of these Alcoa Aluminum Foil packets, with acetate film on one side and thermoplastic seal coating on the other, are being made weekly.

Many materials were tested for these heat and moisture-vapor proof packets but no combination of materials could equal the protection of aluminum foil and plastics.

In your own products, perhaps the combined use of aluminum and plastics will bring added sales and service advantages. Alcoa engineers will be glad to work with you to find out. ALUMINUM COMPANY OF AMERICA, 2175 Gulf Building, Pittsburgh 19, Penna.

ALCOA FIRST IN **ALUMINUM**

In plants from coast to coast, Birdsboro general molding presses and multiple platen sheet presses are passing the toughest performance tests with ease. Operation under actual plant conditions testifies to the minimum maintenance and maximum production standards set by Birdsboro Plastic Presses. If yours is a press problem, it pays to ask Birdsboro.

BUY WAR BONDS

BIRDSBORO STEEL FOUNDRY & MACHINE CO., BIRDSBORO, PA.

BIRDSBORO

HYDRAULIC PLASTIC PRESSES

THERE'S MORE THAN MEETS THE EYE IN PLASTIC HOUSINGS
A housing is the "package" in which your product goes on the market. Therefore it should have eye value . . . sleek lines, smooth texture pleasant to the touch, and in many cases the added beauty of color and lustre.
Plastic housings excel in all these qualities. But they can contribute many more *unseen* features. For one thing, the housing often serves as insulation against electricity or heat. It frequently doubles as a rugged frame which supports complicated interior mechanisms. By virtue of its strength, resistance to water or chemicals, the housing affords protection to the mechanism. Finally, it can be made transparent or opaque, to reveal or conceal what it encloses . . . whichever is desirable.
The variety of housings which we have helped to design and produce has given us the status of specialists. Our backlog of experience will be useful in developing housings for your products. Write to: MOLDED PRODUCTS COMPANY, 4533 W. Harrison St., Chicago 24, Ill.
PLASTICS DIVISION
MOLDED MPC PRODUCTS

Factors Governing the BRIGHTNESS of LUMINESCENT PLASTICS

THE luminescent brightness of plastics depends on several factors: (1) the type of plastic used, (2) the percentage of pigmentation, (3) the thickness of the section, (4) the size of the object, and (5) the method of fabrication.

1. Best luminescent properties, per unit of luminescent pigment, are obtained with water-clear plastics, especially the types that possess good light (both visible and near-ultraviolet) transmission characteristics, such as the acrylics, the styrenes, the acetates, the vinyls, the ureas, and the melamines.

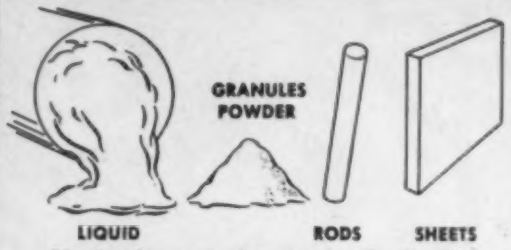
2. **Fluorescent pigments** usually are used in quantities ranging from 2½% to 5% of the pigment based on the weight of the plastic (see variations under 3 and 4 below).

Phosphorescent pigments generally require higher pigmentation — from 5% to 10% for the zinc sulfide types and from 10% to 15% for the calcium and strontium sulfide types (see variations under 3 and 4 below).

3. Thin sections of luminescent plastics require more, and thick sections less, pigmentation. Very thin sections may require even more than the above average percentages. Laminates prepared with a white background also may be used to increase the brightness of thin sections.

4. Small objects require higher pigmentation, and large objects require less. If the object is very small, more pigment than indicated under 2 (above) should be used.

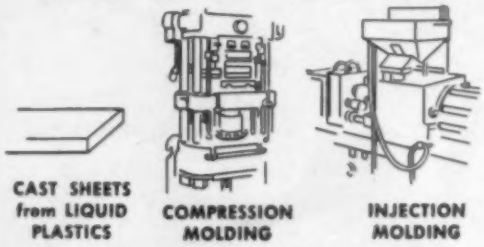
5. The order of brightness, generally speaking, is best with products fabricated so as to subject the pigment to the least mechanical working.



Use luminescent pigments in plastics that are water-clear and transparent to near-ultraviolet and visible radiation.

Thin sections require more luminescent pigment and thick sections less (based on the weight of the plastic) to provide satisfactory luminescent brightness.

Likewise, small objects, such as toggle switch buttons, require more pigmentation, based on the weight of the plastic, than large objects (flashlight or telephone handset, as examples) for suitable luminescence.



Brightness values will depend on the method of fabrication. The least mechanical work favors better brightness.

Other pigments (non-luminescent types) generally should not be used, since such pigments tend to mask or dilute luminescent brightness. When it is desirable, however, to alter the daylight color, very small amounts (0.01% to 0.02%) of soluble dyes may be used without serious effects on luminescent brightness.

MOLDERS
LAMINATORS
FABRICATORS

If your source of supply cannot furnish you with your requirements, write to us for the names of producers of luminescent plastic compounds.

We shall be glad to discuss the use of luminescent pigments in your plastics

THE NEW JERSEY ZINC COMPANY

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Your product—made of LAMICOID, the versatile plastic laminate—can be manufactured and delivered on short notice from our strategically located fabricating plants. These plants are located in the large industrial centers to give prompt service and quick delivery. They are fully equipped to fabricate mechanical, electrical, graphic, translucent and engraving LAMICOID products to meet your specific requirements.

There is a variety of fabric or paper bases —also asbestos or Fibreglas—laminated with the proper thermosetting resin. LAMICOID is available in rods and tubes in a wide diameter range and in sheets of 36" x 42" standard size in a range of thicknesses.

Our fabricating plants and engineering service are available to you for fitting LAMICOID to your product requirements. 'Phone or write the nearest office.

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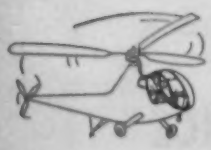
Fiberglas-plastics fabrications by United States Rubber Company for Nash-Kelvinator Corporation.

Fiberglas—glass in the form of fine fibers—twisted into yarn and woven into cloth, possesses many of the properties most sought after in low-pressure laminates.

FIBERGLAS*- REINFORCED PLASTICS

—a spectacular, new, lightweight

Structural Material

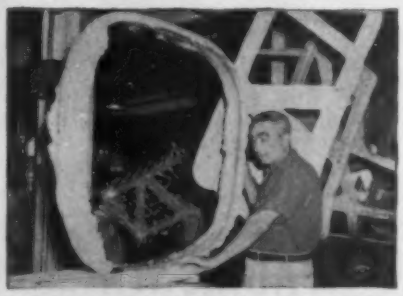


Aircraft structural parts, such as the cabin structure of the Army R-6 Helicopter, are now being made of plastics reinforced with Fiberglas — fine filaments of glass woven into cloth, then used with low-pressure resins in the fabrication of extremely strong, lightweight laminated plastics parts.

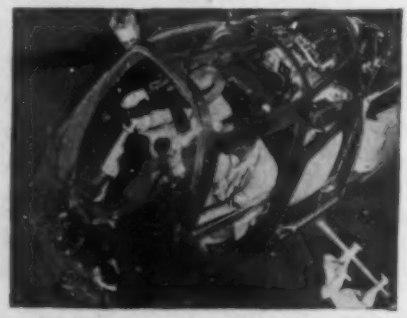
Fiberglas textiles are resistant to moisture, therefore are dimensionally stable. They possess great tensile strength, and are resistant to heat, oils, corrosive vapors and most acids.

The combination of Fiberglas and certain low-pressure resins has resulted in a material with properties which excel those of any material previously available for commercial use. For example, impact strength from five to ten times that previously obtained in laminates is now attained through Fiberglas reinforcement. Higher strength-to-weight ratios, greater rigidity, dimensional stability and simplified fabrication are but a few of the advantages which are resulting in the rapidly increasing use of Fiberglas for reinforced plastics sheets and formed parts.

Samples and complete information on Fiberglas Textiles will be sent to you on request. Owens-Corning Fiberglas Corp. does not manufacture resins or finished laminates but will be glad to furnish data on techniques in the use of Fiberglas and low-pressure resins. Write: *Owens-Corning Fiberglas Corp., 1876 Nicholas Bldg., Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ont.*



R-6 cabin structure of Fiberglas-reinforced plastic being trimmed and made ready by U.S. Rubber for shipment to Nash-Kelvinator.

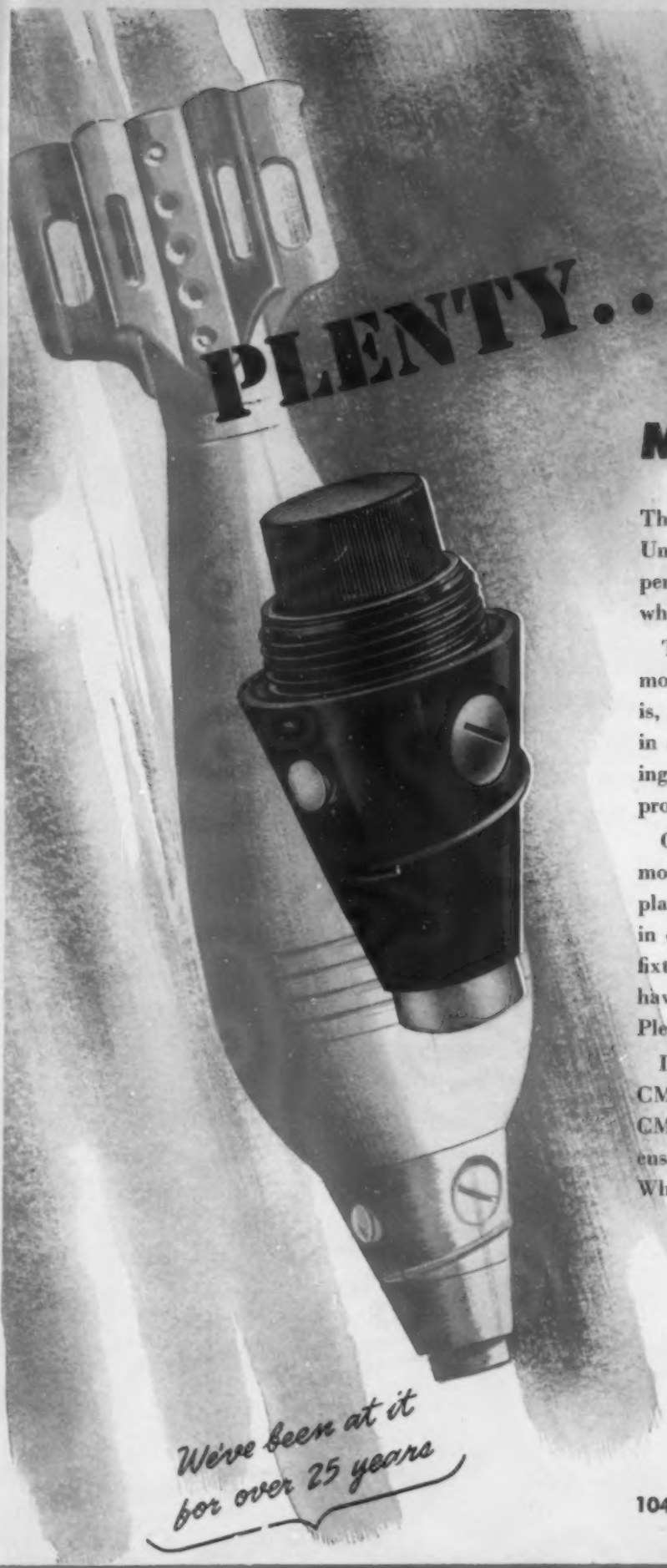


The R-6 Helicopter which will be used to transport wounded from inaccessible combat areas and will service military outposts with supplies.

ARMY E NAVY

FIBERGLAS . . A BASIC MATERIAL

*T. M. Reg. U. S. Pat. Off.



PLENTY...ON TIME

...THANKS TO MOLDED PLASTICS

The trench mortars are doing a big job these days. Until the big guns come up, the infantry must depend on them as its only mobile artillery. That's why they need plenty of ammunition . . . and fast.

The business end of the trench mortar shell is molded of plastic . . . and a tricky bit of molding it is, requiring extreme precision all along the line, in engineering, mold-making, molding and finishing. And, as to quantity, it's the largest mass-production job ever undertaken by the industry.

CMPC is proud to be one of the top ranking molders selected to produce this important molded plastic fuze. As usual, we made the intricate molds in our own plant as well as the complicated jigs, fixtures, and inspection devices. And, as usual, we have been meeting delivery dates as per schedule. Plenty . . . on time.

If your plans call for molded plastics you'll find CMPC a mighty good place to do business. A CMPC Development Engineer will be glad to discuss your problems with you . . . without obligation. Why not ask for his services today?

We've been at it for over 25 years

CHICAGO MOLDED PRODUCTS CORPORATION

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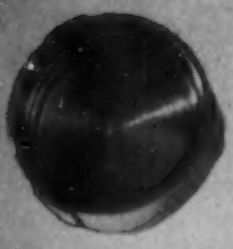
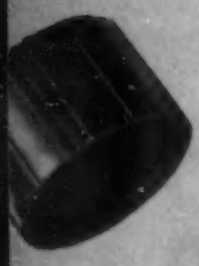
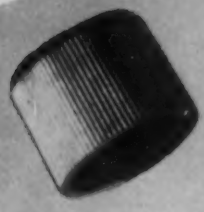
Mold Automatically

IT PAYS . . .







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For low-cost closures or similar threaded parts, it will pay to Mold Automatically. Stokes Presses are simple, fully safeguarded, completely automatic, with split-second timing. There can be no under or over cure, caps are of the highest quality. A single operator tends a battery of machines. A single mold only is required.

Machines are fast . . . the entire time required for loading, closing, opening, unscrewing and ejecting is 7 to 10 seconds only. To this add time for cure, which varies with cup size and material, and you obtain a 40 to 60-second cycle for most caps. Thus, if a 50-second cycle is required for 20-mm short skirt caps, hourly production would be 5,832 caps.

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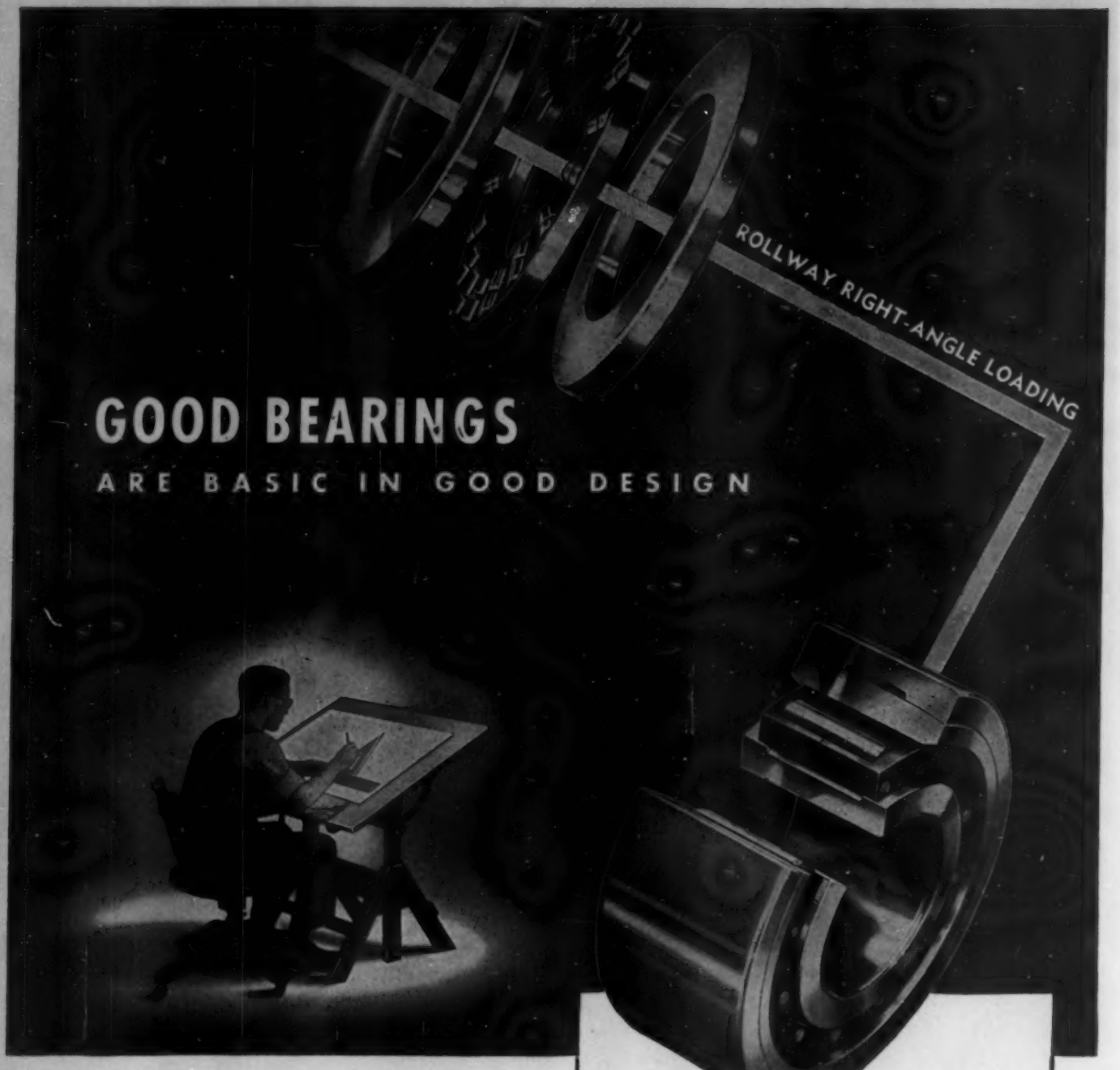

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ARE BASIC IN GOOD DESIGN

You won't get far in postwar competition without good bearings. And for any machine, a good bearing means simply that type which handles the load most efficiently and economically with the least maintenance cost and worry. That's where Rollway's Right-Angle Loading shines. It reduces load magnitudes and simplifies stresses. There's no piling of thrust loads on radial bearings or radial loads on thrust bearings. Shut-downs for bearing service and replacement are few and far between.

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A change to Phillips Recessed Head Screws ruled out driver skids . . . permitted use of power methods. Also eliminated one operation involving countersunk washers. All of which added up to substantial cost-savings!

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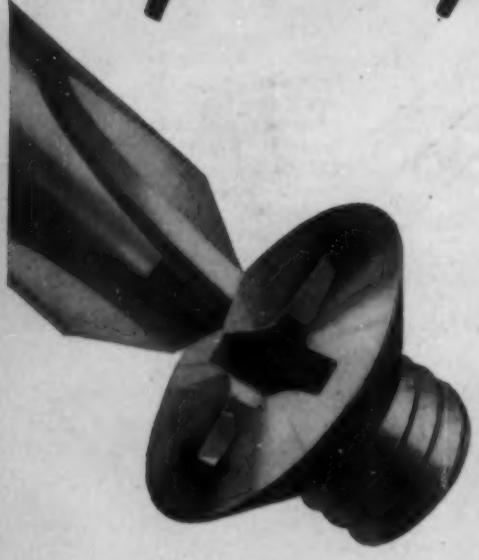
Besides being strength-builders, Phillips Screws are also great little sales-builders. They help dress up any product . . . do away with unsightly burrs that snag clothing and make an otherwise sweet piece of merchandise look sour!

It's Phillips — the engineered recess!



In the Phillips Recess, mechanical principles are so correctly applied that every angle, plane, and dimension contributes fully to screw-driving efficiency.

. . . It's the exact pitch of the angles that eliminates driver skids.

. . . It's the engineered design of the 16 planes that makes it easy to apply full turning power – without reaming.

. . . It's the "just-right" depth of recess that enables Phillips Screw Heads to take heaviest driving pressures.

With such precise engineering, is it any wonder that Phillips Screws speed driving as much as 50% – cut costs correspondingly?

To give workers a chance to do their best, give them faster, easier-driving Phillips Recessed Head Screws. Plan Phillips Screws into your product now.

PHILLIPS *Recessed Head* SCREWS

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How to Shorten Molding Cycles And Increase Your Output 50%

Two years' experience shows quicker press closing, shorter curing, fewer rejects when electronic preheating is used.

ELECTRONIC preheating can often make important savings in time in all three steps of the molding cycle—press closing, curing, and removing the finished piece. On the average, the overall increase in press output is about 50%.

Here's Proof: One user* of RCA electronic heating equipment reported that a single RCA 2000-watt generator *doubled the output of two presses and of the thirty men* engaged in that particular molding job. And rejects were cut from 60% to 10%!

A second application by this same molder reduced the operational time of each press by 50%; and the decrease in rejects produced an overall gain in output of 400%!

Tests conducted by a manufacturer of molding materials* to determine the advantage of electronic preheating in molding thick sections showed a reduction of necessary curing time in the mold from 2½ hours (old molding method) to 5 minutes (electronic preheating). Test blocks were 2¾ inches thick; quality of results was in most respects better with electronic preheating.

Why Is Electronic Preheating Effective? Because it brings preforms to uniform temperature, and hence uniform plasticity—ideal plasticity—in only a few seconds. Not only does the molding material soften completely—with no hard centers—but it softens so quickly that premature setting cannot take place.

Quick Press Closing: With electronic preheating, there's no delay in press closing—no need to wait for the material to soften due to mold heat. Flow begins at once. Molding pressures are often reduced by as much as 40% to 50%. And that may mean a better product in cases where high pressures formerly displaced inserts, or damaged intricate molds.

Quick Curing: Because the molding material is at uniformly high temperature when molding begins, only a short time is needed for mold heat to produce an excellent cure. Acetone extractive tests in one case showed that a 1½-minute cure after electronic preheating was more effective than a 7½-minute cure with ordinary preheating.

Perhaps Electronic Preheating Can Help You: To find out, at no cost to you, write today for RCA engineering advice. Include details of material; preform size, shape, filler; present molding method; press cycle time; and a statement of your molding problem in which you think this method might help. Or the coupon will bring you further information, if you wish. Address: Radio Corporation of America, Electronic Apparatus Section, Box 70-191X, Camden, N. J.

*Name on request.

RCA ELECTRONIC HEAT

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We have prepared a data sheet and photo-folder of TULOX end-uses. May we send you one?

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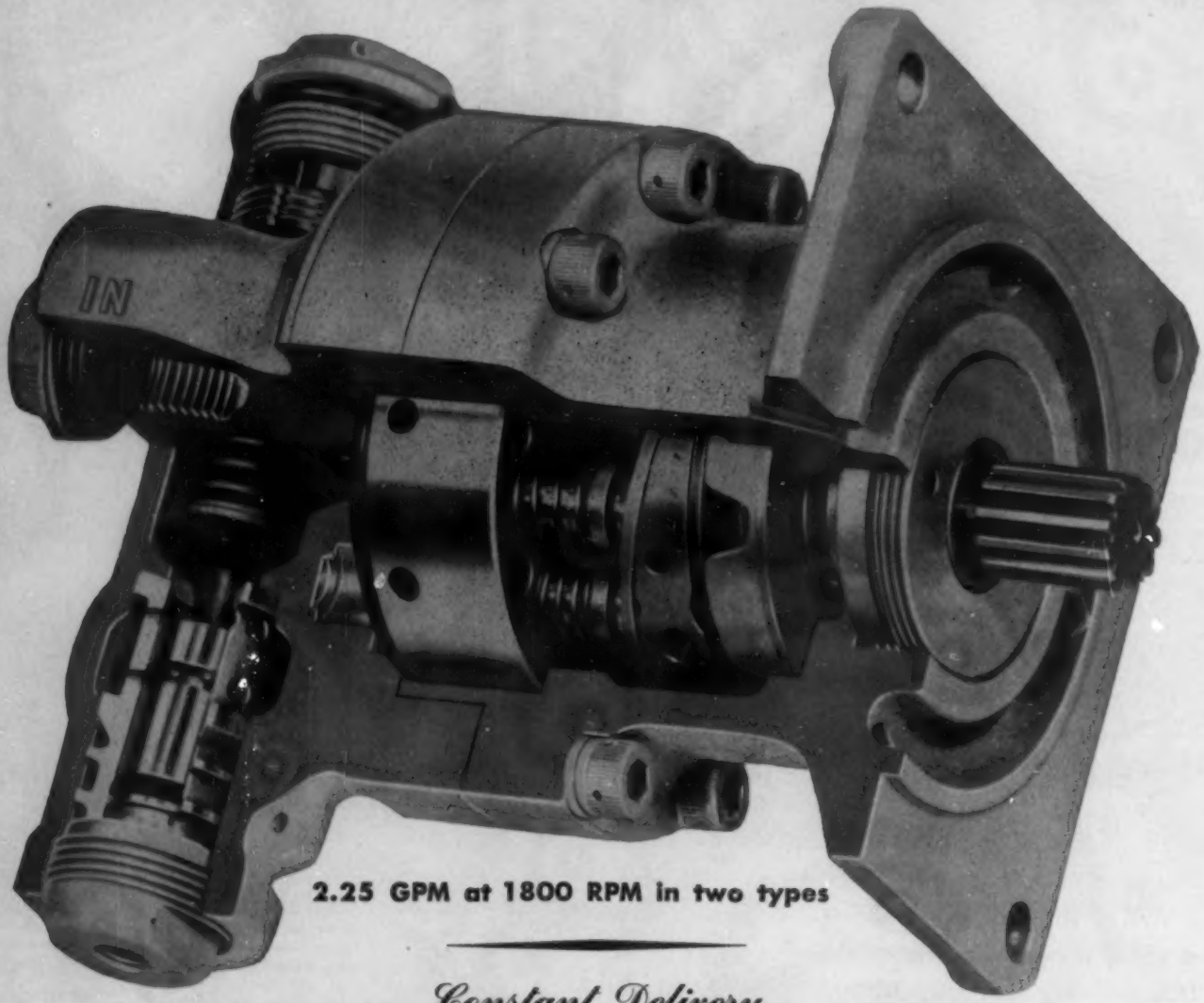

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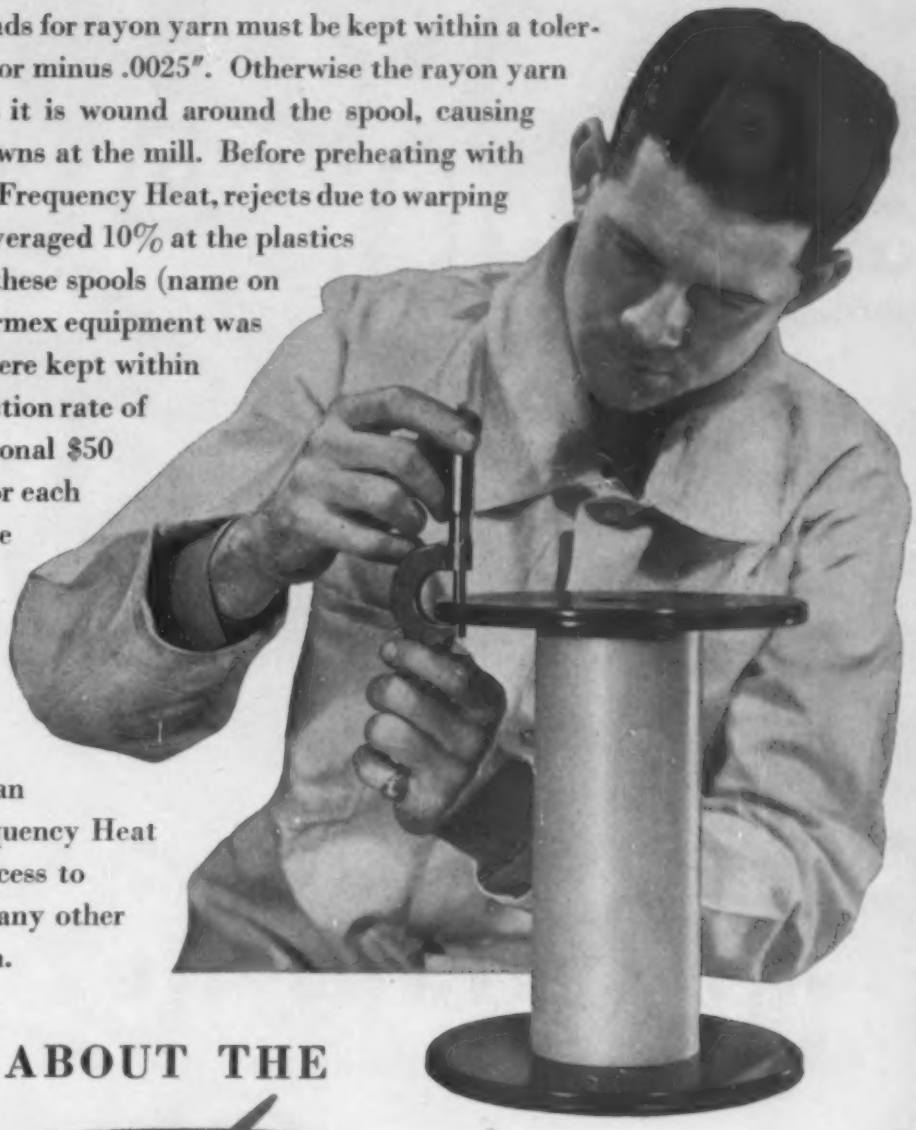

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OUR AMERICAN SOLDIERS

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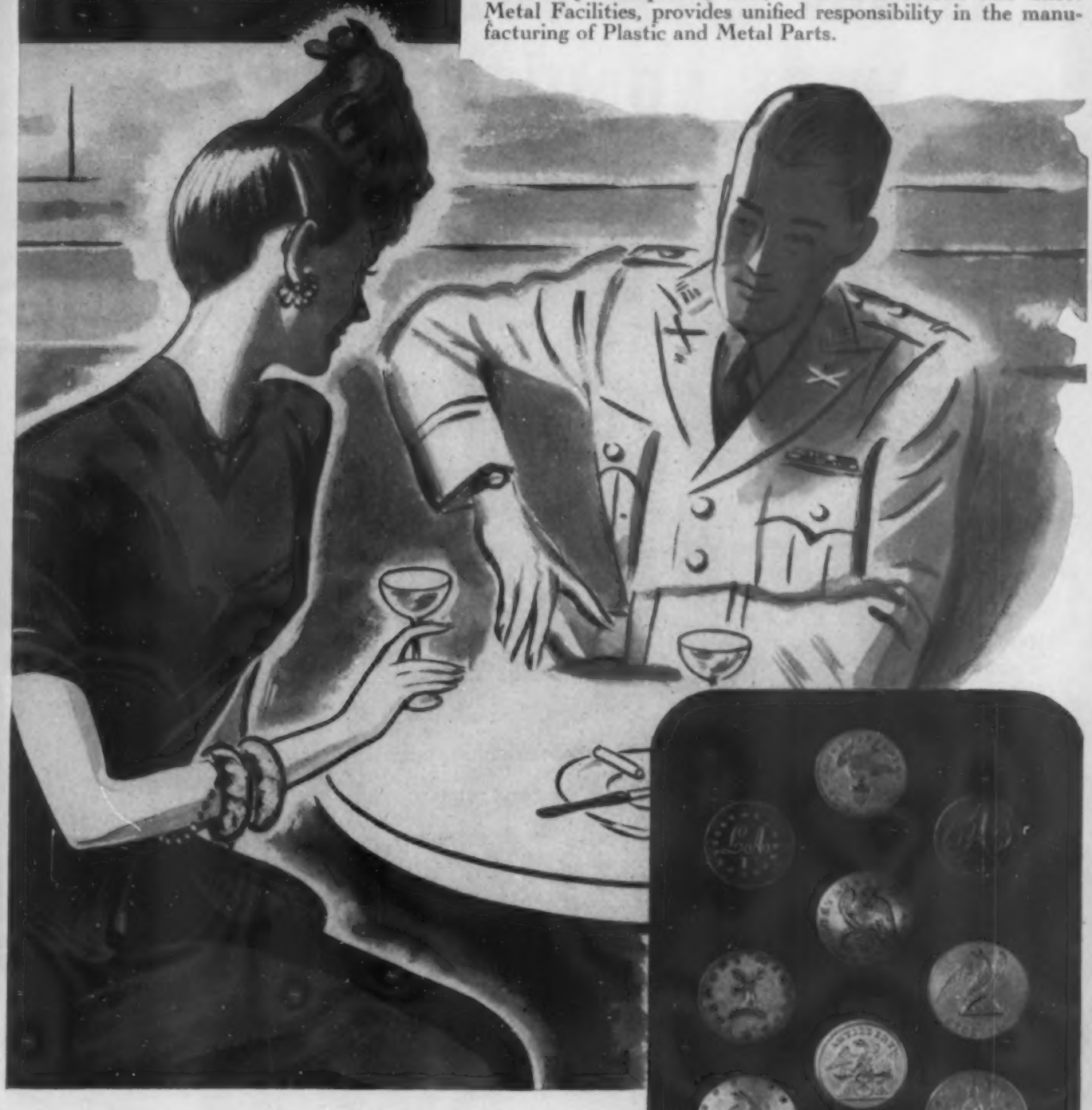

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WATERBURY COMPANIES, INC.

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Hardesty Chemical DIBUTYL SEBACATE has high solvent power for most resins and elastomers, and is therefore easily incorporated into the plastic mass with a minimum of milling. Hardesty Chemical DIBUTYL SEBACATE is tasteless and has no residual odor. It is extremely resistant to yellowing on long exposure to light and retains its plasticizing effect at extremely low temperatures.

A letter to HARDESTY CHEMICAL COMPANY will bring a sample and further information by return mail.

Properties of Dibutyl Sebacate

Purity	98.5% Minimum
Specific Gravity	0.935 20/20°C
Acidity as Sebacic	0.3 Maximum
Ash	0.001% Maximum
Iron	0.3 ppm Maximum
Butanol	0.1% Maximum
Flash Point	380°F
Boiling Point	344°C @ 760 mm 175–180°C @ 3 mm
Water Solubility	Less than 1% @ 25°C
Freezing Point	11°F
Dielectric Constant	3.6
Power Factor	60 cycles

HARCHEM

PLASTICIZERS

Alkyl Roleates
Dibutyl Sebacate
Sebacic Acid
Capryl Alcohol

HARDESTY CHEMICAL COMPANY, INC., 41 EAST FORTY-SECOND STREET, NEW YORK 17, N.Y.

DEEP COMPRESSION MOLDING with MEGATHERM* Electronic Heat

They said it couldn't be done — but the Kuhn & Jacob Molding & Tool Company of Trenton, New Jersey did it . . . *with Megatherm!*

All previous attempts to compression-mold this heater-coupling with ordinary methods of preform heating, had resulted in rejection ratios as high as 99 to 1. Because of its large size, irregular shape, and variable thickness, it posed a difficult production problem.

But the high-speed uniform heating of the rag-filled resin-bonded preform with Megatherm electronic heat resulted in flawless finished couplings with a smooth surface and minimum flash that passed rigid inspection tests 100%.

Here is another proof that Megatherm can do the job better . . . not only in production problems involving large parts, irregular shapes, and variable thicknesses, but in run-of-the-mill operations.

And as a result, more and more plastic processors are installing Megatherm . . . the modern tool for modern industry. Get the story on Megatherm now.

FEDERAL TELEPHONE & RADIO — FTR

Federal Telephone and Radio Corporation

*Reg. U. S. Pat. Office — INDUSTRIAL ELECTRONICS DIVISION — Newark 1, N. J.

An IT&T Associate

ingeneering*

NOW...FOR THE AGE OF FLIGHT TOMORROW

A postwar sky giant's lightest structural load will be its plastics parts. From tiny corrosion-resistant fittings and transparent, flexible fuel lines to colorful, decorative panels, seats and upholstery, specialized plastics will give greater permanence at a fraction of the weight of the materials they replace.

INGENEERING* by Victory Plastics Company has resulted in unique, compression-molded plastics laminations that are adaptable to numerous uses in the aviation industry . . . And to other industries . . . your industry . . . similar applications of ingenuity to the creation, design and fabrication of postwar plastics products will give you advantages over competition. Victory Plastics Company, 80 Scabbard Street, Hudson, Massachusetts.

INGENEERS OF PLASTICS PRODUCTS

Victory PLASTICS COMPANY

COMPRESSION • TRANSFER • INJECTION • LAMINATION • SATURATION

COPYRIGHT 1945, VICTORY PLASTICS CO.

41.3% Greater Tensile Strength

for Plastic Parts

METAL PLATED by MONROE

UNPLATED

and consider these OTHER ADVANTAGES . . .

Plastic parts *plated by the Monroe process* . . . successful with any plateable material . . . have substantially greater flexural strength also . . . greater impact resistance . . . greater dimensional stability . . . increased resistance to heat and cold flow . . . greatly increased resistance to absorption and corrosion . . . and they have interesting possibilities for use in the field of electronics . . . so . . . if you want to make products better . . . more attractive . . . at less expense . . . *investigate Monroe Metal Plated Plastics.*

PLASTICS DIVISION

MONROE

MONROE AUTO EQUIPMENT CO. . . . MONROE, MICH.

THE METAPLAST PROCESS

Assistance offered your designers and engineers for testing specific applications.

ARMY (E) NAVY

Don't get caught Napping

while "Fastening Bugs" creep into your post-war product plans

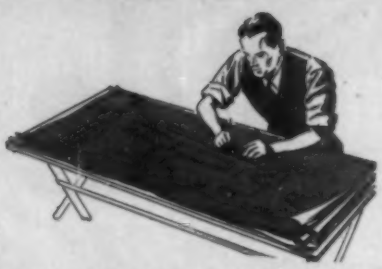
Now is the time to decide on fastenings for your post-war product – while it is still in the design stage. Too many products are all tooled up and in production before "fastening bugs" are discovered. Why wait to change *later?* Why sacrifice the savings you could be making from the start?

You will want to use P-K Self-tapping Screws wherever possible, because this *short cut fastening method* can save you from 30% to 50% in assembly time and labor. Experience proves you can save time – speed assembly – cut costs – reduce rejects – in 7 out of 10 cases.

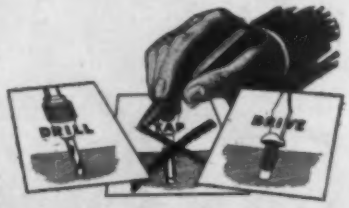
P-K Type "F" Screws eliminate tapping "bugs", drive faster, hold securely in Bakelite assembly

This Pierceway Sectional Plastic Surface Wiring System is a time-saving convenience widely used in busy industrial plants. The two parts of the molded Bakelite housing are assembled by the "short cut" method, eliminating tapping. Find out now if needless tapping "bugs" are hiding in *your* plans.

HERE'S HOW TO START ASSEMBLY SAVINGS WHEN YOU START PRODUCTION



1. ***QUESTION EVERY FASTENING*** in your plans. Ask – "Can it be done the simpler way – with P-K Self-tapping Screws?" – before you O.K. more complicated methods.



2. ***ELIMINATE NEEDLESS TAPPING,*** awkward bolting, costly inserts that slow up molding, by specifying one of the several types of P-K Self-tapping Screws designed for plastics assemblies.

3. ***ASK A P-K ASSEMBLY ENGINEER*** to go over your plans with you – to make sure you find all the "bugs". You'll find his advice unbiased, because Parker-Kalon makes all types of Self-tapping Screws. Or, send assembly details for recommendations. Parker-Kalon Corporation, 208 Varick St., New York 14, N. Y.

PARKER-KALON
Quality-Controlled
SELF-TAPPING SCREWS

For Every Metal and Plastic Assembly

HOBBING PRESSES

Success in Plastic Molding starts with the Molds

Sinking intricate hobs into prepared blanks of cold steel calls for irresistible force in displacing the metal; instant response to skillful manipulation; sensitive control for *precision* accuracy. Elmes hydraulic hobbing presses provide these three essentials; and they give to the operator that most important element of quality work—*implicit confidence* in his equipment.

Elmes hobbing presses are rugged, rigid, compact. Pressures measured in millions of pounds produce no objectionable deflection, no apparent strain on any part. Floor space and height give little indication of the tremendous force these capable presses exert. Control is *effortless;* slide movement smooth and *exact.*

Simplicity and ease of operation are combined with speed and safety. The operator observes his work through a bullet-proof glass shutter for protection against shattered hobs or blocks. Rapid slide traverse saves time. Controllable hobbing speeds meet every need.

Cavities hobbed on Elmes presses have an *excellent* start toward *perfect* completion. Ask us to show you how these presses can improve your own production.

ELMES HYDRAULIC EQUIPMENT

6,000,000-lb. capacity Elmes hobbing or die sinking press—Model No. 5389. Metal side shields and a bullet-proof glass front shutter enclose work compartment. A micrometer depth gage indicates slide movement. Compact, self-contained, with integral pump and Elmes simplified controls. Made in all sizes and capacities.

ELMES ENGINEERING WORKS OF AMERICAN STEEL FOUNDRIES, 225 N. Morgan St., Chicago 7, Ill.

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UNITED—a front line pioneer—has for many years been the leading supplier of tubes for the most widespread field of R-F heating . . . Diathermy.

Heavy Duty oscillators and power supply mercury rectifiers by UNITED are popular among users of H-F induction heating because they "stand up" under the fluctuating demands of this application.

To lower your operating costs, through increased life expectancy of your tubes, equip with the UNITED tubes, ideally designed for H-F heating . . . Write for technical data and tube interchange information.

UNITED ELECTRONICS COMPANY

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Universally used and endorsed by engineers everywhere

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The leaders in practically all industrial fields, almost without exception, use Timken Bearings in the products they make — the machines they operate. Such acceptance is due to but one fact — Timken Bearings mean dependable performance. Low cost operation and maintenance are common denominators to all industry and that is why Timken Bearings solving these problems, are a basic and integral part of all industry. It is the reason why engineers, not only in America, but throughout the world, recognize the advantages inherent in Timken Bearings. To insure the utmost in anti-friction bearing performance — first have the application engineered by The Timken Roller Bearing Company and then use the Timken Bearing that our experience recommends.

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TAPERED ROLLER BEARINGS

ALL THERE IS IN BEARINGS

Bazookas are not new in plastic molding!

True, the concussion and deadly intent are lacking. And the aftermath is constructive rather than destructive. But the compelling forcefulness of the principle in lowering sales resistance bears a striking similarity.

Plastic moldings, to "move" at point-of-sale, require commercial bazookas—eye attraction, sleek finish, functional design, rugged construction, etc. Each in its own way, is a prerequisite in tearing down sales resistance, competition and costs.

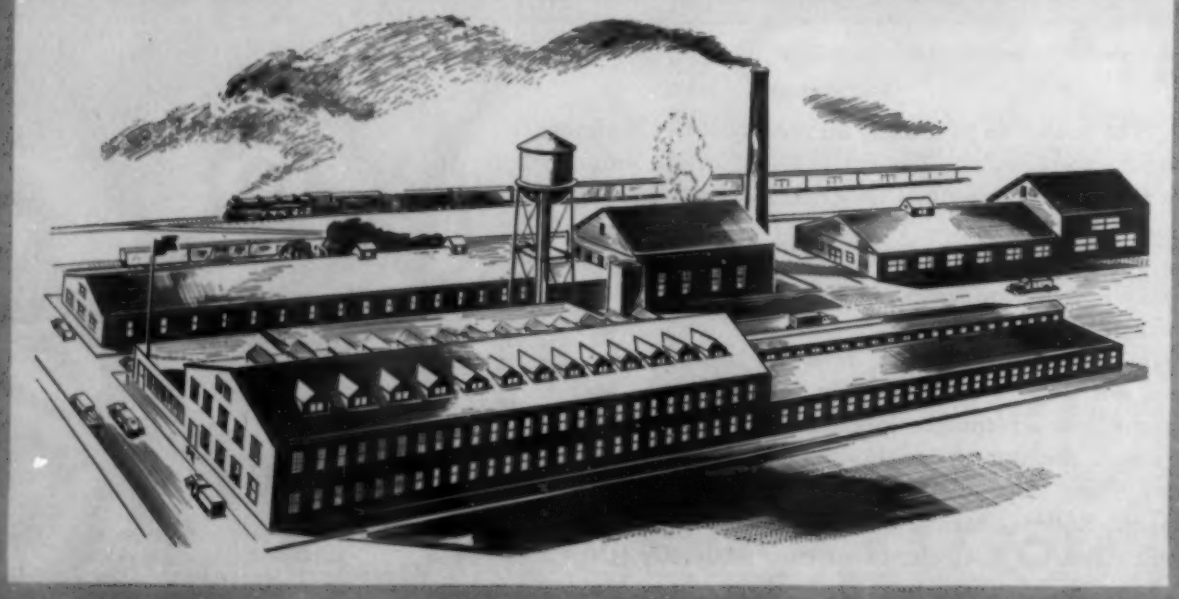
Skill is the ammunition—a quarter century of molding for all phases of industry; facilities are the weapon—three plants for efficiently meeting requirements . . . Wayne, New Jersey; Arlington, Vermont; Waterloo, P. Q., Canada. The bull's eye is the result of close collaboration between all our engineers and technicians.

This versatile "bazooka" can be aimed at your post-war target by addressing inquiries to Mack Molding Company, Inc., 120 Main Street, Wayne, New Jersey.

Mack MOLDED EXCELLENCE

Here is the "home" plant of MACK MOLDING—located conveniently in the New York Metropolitan area. Another completely equipped plant which will be ready for your plastic molding plannings when the war ends.

SALES OFFICES: NEW YORK CITY, INDIANAPOLIS, CHICAGO, DETROIT, BOSTON & ST. LOUIS



THESE THREE MACHINES ARE BEING USED IN

PROCESSING DOZENS OF DIFFERENT PLASTICS

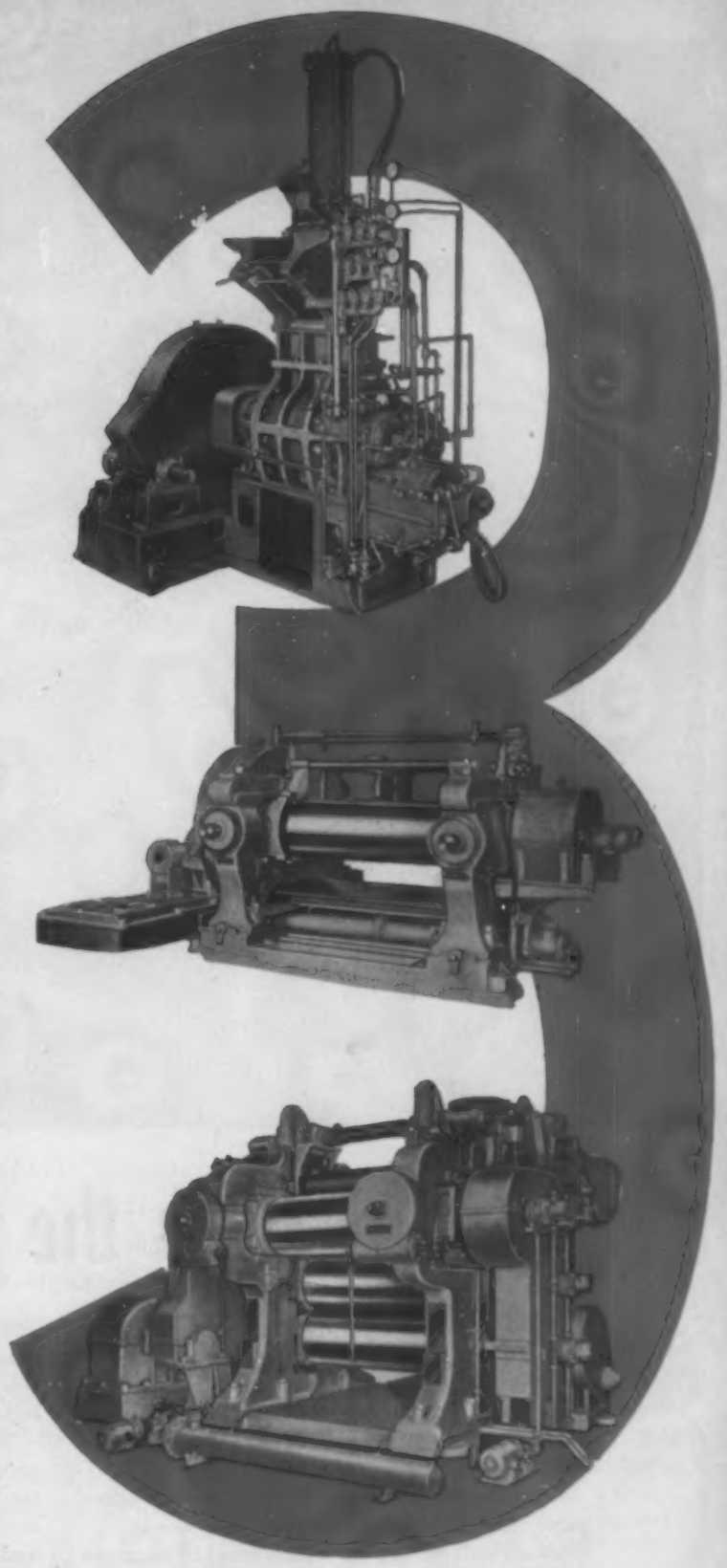
HERE ARE SOME REASONS WHY:

BANBURY MIXERS produce mixes of exceptional uniformity and superior quality, with large savings in power, labor and other costs. The heat necessary in handling plastics can be maintained at constant temperature. A wide variety of materials, colors or formulas can be processed without difficulty. Dust and fume hazards are eliminated. Positive, automatic, mechanical control of entire mixing procedure is provided.

ROLL MILLS are designed for high temperature converting and mixing, and are provided with attachments and equipment to suit individual requirements. Chamber-bored rolls, fitted with special type stuffing boxes, are carried in water-cooled, flood-lubricated journal boxes. High strength materials provide the ruggedness for heavy duty service. A patented shear pin safety device prevents breakage of housings and other parts in case of overloading. For stocks which are sensitive to contamination, the rolls can be chrome-plated and the adjustable guides and mill pan made of non-corroding metals.

CALENDERS for sheeting and coating plastics are available with any number and arrangement of rolls, and fitted with attachments to suit their particular function. Rolls are chamber-bored for high-pressure steam circulation, and are carried in full bronze-lined journal boxes, flood-lubricated by a continuous circulating oil system. Many other features also contribute to efficient operation and product quality.

Banbury Mixers, Roll Mills and Calenders are built in a wide range of sizes for either laboratory or production use. Write for further information about any of these machines.



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Farrel-Birmingham

Turn Back the Clock to 1920

Compare this view of Manhattan as it looked in 1920 with the way it looks today. Twenty-five years have made a difference... the city has moved forward... grown bigger... taller... and the story of its progress is etched in its skyline.

Organized in 1920, the Witco Chemical Company, too, has grown swiftly and steadily... from a small office with a personnel of four to a world-wide organization. Now entering its second quarter of a century with a list of more than 200 chemicals, oils, pigments, asphalts, and other products, Witco is prepared to meet the chemical requirements of a fast expanding industrial world.

Witco invites you to test the quality of its products... to use the facilities of its modern research laboratory and the services of its experienced research staff.

WITCO PIGMENTS

Recommended for high quality and uniformity. Available in wide variety for use in plastics. Can be depended upon to give consistently satisfactory results. Backed by technical cooperation of Witco Research Laboratories. Samples available.

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[Formerly Wishnick-Tumpeer, Inc.]

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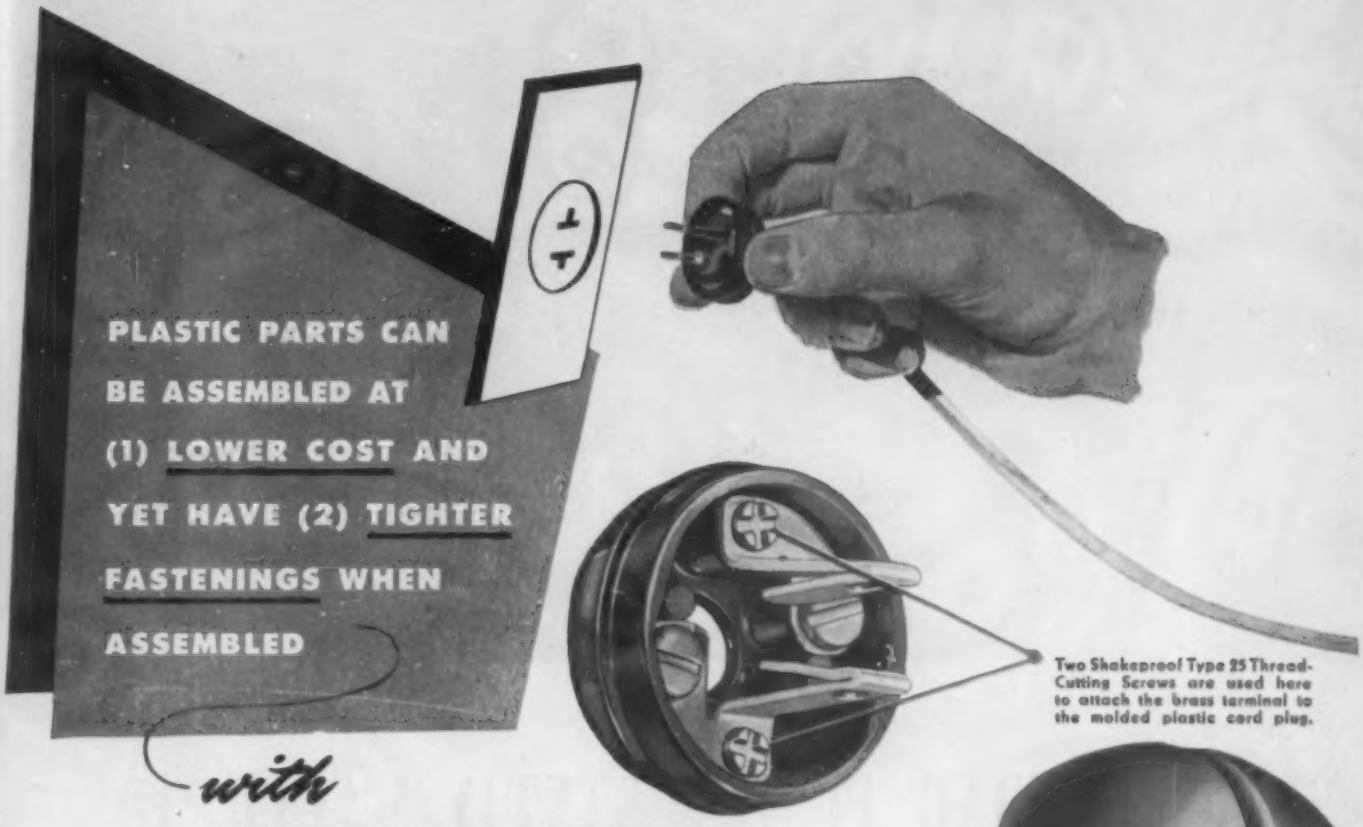
THIS *Plug* PROVES TWO POINTS!



Two Shakeproof Type 25 Thread-Cutting Screws are used here to attach the brass terminal to the molded plastic cord plug.

with

SHAKEPROOF TYPE 25 THREAD-CUTTING SCREWS

The unique cutting action of this screw, specially designed for plastic applications, assures freedom from dangerous stresses or strains that are likely to cause fractures in molded plastic parts. Thus, its use permits elimination of both threaded inserts and separate tapping operations with the resulting important savings. Also, because these screws remain in the threads they have cut themselves, a perfect mating fit is assured which results in absolutely tight connections that are able to stand up longer under hard usage. Try this screw on your plastic fastening applications. It will quickly prove its practical advantages.

TEST THE TYPE 25 ON YOUR PRODUCT NOW!

A convenient kit of samples in various sizes and head styles is offered free without obligation. Send for yours today!

ARMY NAVY

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NOW FLYING AT THE SANTAY MASTHEAD

☆ The coveted Army-Navy Production Award was presented to the Santay Corporation on March 24, 1945! It represents official recognition for the fine record established by Santay in producing war equipment. The entire Santay organization is justifiably proud of this award . . our country's expression of approval for a job well done. All of our facilities have been working 24 hours a day for many months, for VICTORY! Santay's war production has concentrated upon our regular type of products . . injection molding, metal stamping and electro-mechanical assemblies. The skill and precision craftsmanship for which Santay workers are widely known are indicated in this award. These same fine qualities can be depended upon in *post* war production in equal or surpassing measure to that employed in our production *before* and *during* the war.

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The Best is yet to come
GOODYEAR
THE GREATEST NAME IN RUBBER
That these things will be, as soon as peace makes them permissible, is the promise of Goodyear—a promise backed by more than 200 scientists working with the world's finest experimental equipment. On their record of 40 years and more of notable accomplishments you can be sure, indeed, that "the best is yet to come."

The words that JUMPED RIGHT OUT at us!

Goodyear installation of a National 2½" Plastics Extruder oil heated and thermostatically controlled. Equipment is particularly adapted for materials having extruding temperature up to 475° F. Compactness and cleanliness are important features.

AT Goodyear Research Laboratories, modern as the day after tomorrow, scores of different plastics compounds are extruded into various shapes and forms for further research, testing, and analysis.

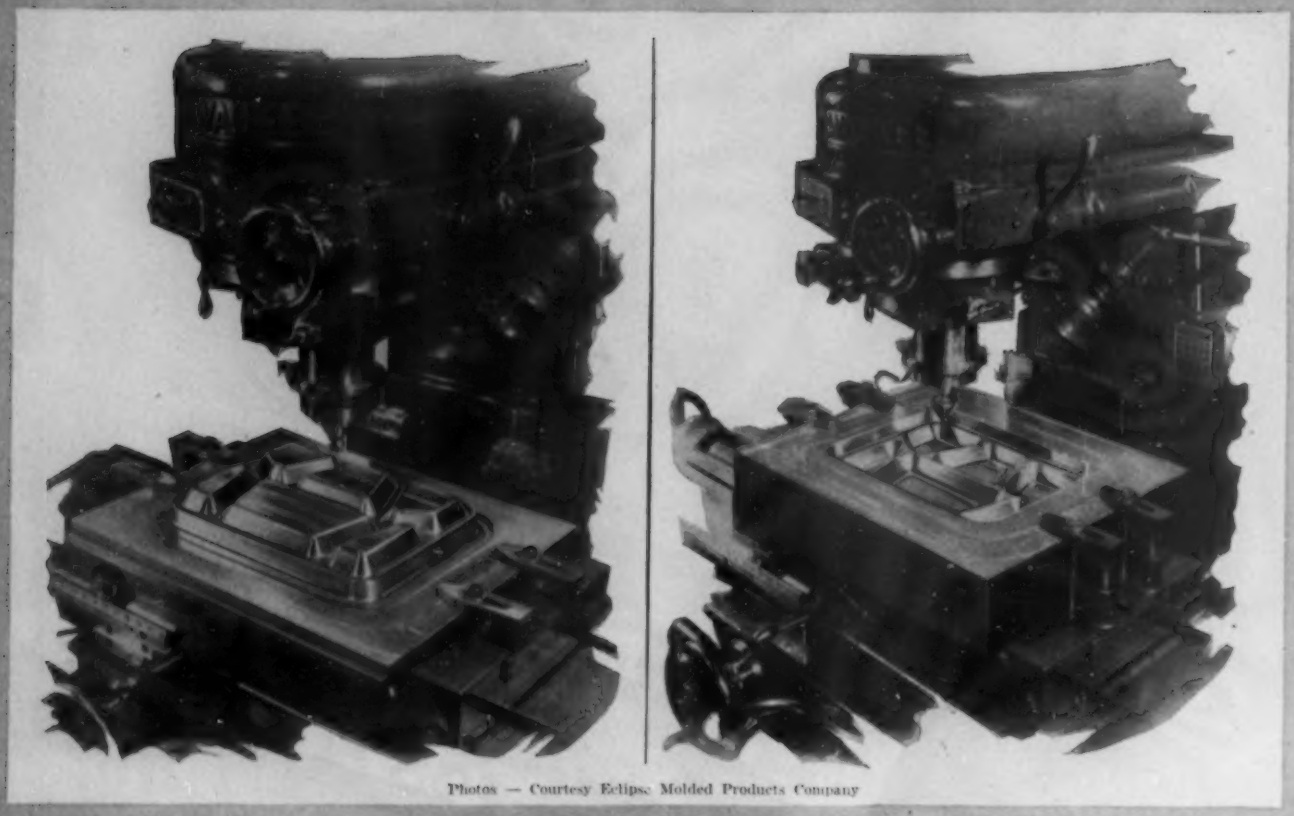
Goodyear selected a National Rubber extruder for experimental runs because this equipment provides the necessary flexibility and meets the exacting requirements of their far reaching research work.

Whether for laboratory or mass production, National Rubber's Plastics Extrusion machinery can help you with *your* plastics production problems. Write for further information, today.

NATIONAL RUBBER MACHINERY CO.
General Offices: Akron 11, O.

Plastics
MACHINERY DIVISION

How would you handle this Job in your Shop?



Photos — Courtesy Eclipse Molded Products Company

1001-PC

Molds for plastics pose some tough milling problems occasionally. Here's a tray mold — that could have been difficult, but it was completed on a Milwaukee Rotary Head Milling Machine with typical speed, economy, and accuracy.

Read this job report —

TRAY MOLD

CAVITY SIZE — width, 12 inches, length, 15½ inches, depth, 1½ inches.

Time required for milling both mold halves complete — 219 hours.

All form cutters milled to correct size and shape on the Milwaukee Rotary Head Milling Machine.

Check these advantages of the Milwaukee Rotary Head Milling Machine and how you can benefit from them in your own shop:

DIRECT . . . mills mold cavities in a single set-up without the aid of templets or models.

ACCURATE . . . chances for error are eliminated because there is no change in set-up. Exact control of all combinations of cutting movements—possible only with this machine—transmits mathematical precision to the work.

FAST . . . initial job preparation and set-up time is reduced to the minimum. Accurate performance of the machine saves operator's time and rapid production of intricate molds and dies is the result.

Write for Bulletin No. 1002C and complete information.

BUILDERS OF MILWAUKEE ROTARY HEAD MILLING MACHINE • MIDGETMILL • SPEEDMILL • FACE MILL GRINDER • AUTOMETRIC JIG BORER • CENTER SCOPE.

Kearney & Trecker

Products

CORPORATION

Milwaukee 14, Wisconsin

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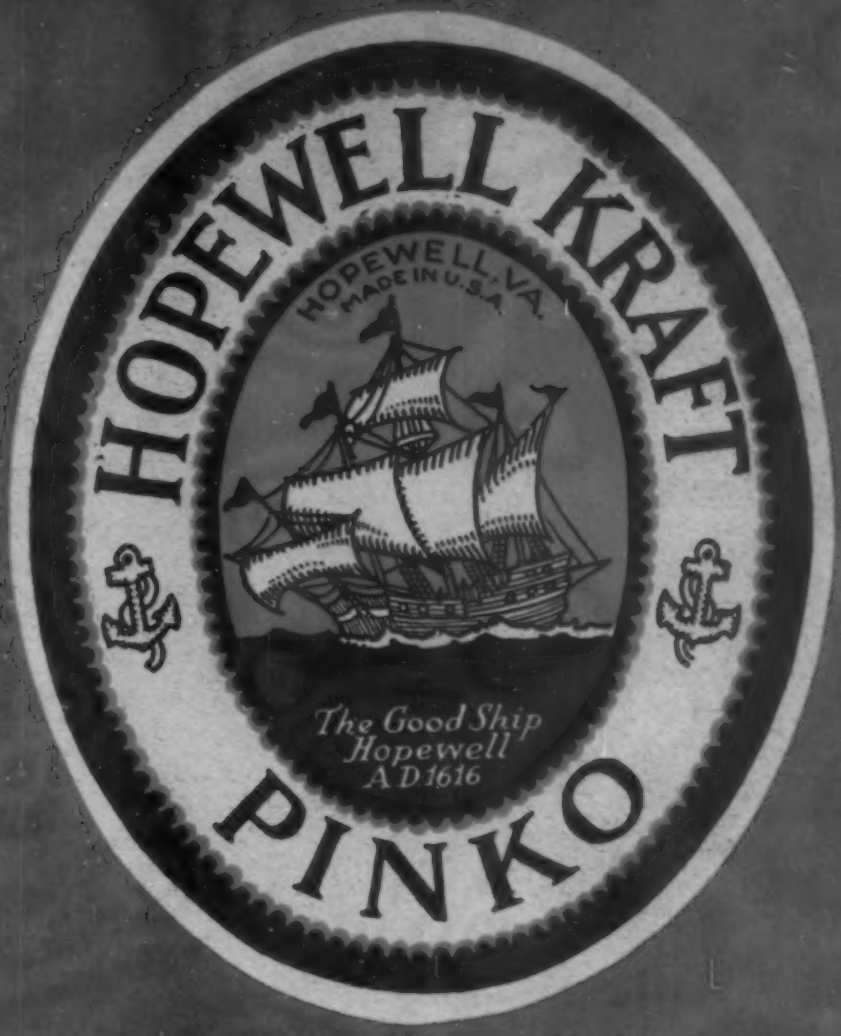

Calipers .006 to .050—Absorbency Numbers 1 to 5

PLASTICS RESEARCH DIVISION

HUMMEL-ROSS FIBRE CORPORATION

Hopewell, Virginia

Originators • • Creators

THIS IS .006 PINKO - - No. 5

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If It's Tubing You Need
YARDLEY MAKES IT

Any shape. Any color. Any thermoplastic material. We have the facilities, experience and skill necessary for making extruded tubing of every type. Whether your tubing requires rigidity, flexibility, toughness at all temperatures, electrical applications or resistance to acids, alkalis and oils; consult us.

Among the various tubings we now extrude are:

SARAN	***VINYL***
ACETATE	***STYRALLOY***
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YARDLEY *Plastics Co.*

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Extruders of SARAN, CELLULOSE ACETATE, BUTYRATE, POLYSTYRENE, STYRALLOY and VINYLS. Also Injection and Compression Molding.

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THE ALMOST INDISPENSABLE

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FLEXIBLE JOINTS

Fluids—oil, gasoline, water, steam—are the very life-blood of America's vast production program. And everywhere throughout industry and transportation, Barco Flexible Joints protect the arterial system which conveys these liquids and gases against vibration, impact and shock. For over 30 years, Barco has led in its field... developing flexible joints for every need. Write for catalogue to the Barco Manufacturing Company, Not Inc., 1809 Winnemac Avenue, Chicago, 40, Ill.

Not just a swivel joint... but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.

here's help for busy plastics "intelligence officers"

To be as helpful as possible during this time of swift technical developments in plastics, Monsanto has instituted a new Bulletin Information Service, to which you are welcome.

This service is Monsanto's solution to the growing problem of keeping the technical minded plastics man completely informed so that he can make the best possible use of the new materials being developed and the new qualities being added to the familiar, established materials.

These bulletins are issued as soon as new developments are authenticated in the laboratory and the field ... without waiting for fancy printing or arbitrary publication dates.

If you have need in your business for these plastics "communiques" we will be glad to place your name on our Bulletin Information Service mailing list. Meanwhile, scan the list of current Monsanto bulletins and publications; if there are any here that interest you, order them with the convenient coupon below. All are free, of course. Address: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield 2, Mass.

A	The Family of Monsanto Plastics — A guide for product designers	X400-1	Divinylbenzene
B	Resinox — A Monsanto plastic	X500-1	Thalid resins for impression molding. Fabrication information
C	Lustron — A Monsanto plastic	X500-4	Thalid for impression molding. Application information
D	Monsanto Plastics — A data book for molders and fabricators	X500-5	Thalid — Glass cloth laminates. Physical properties
E	How Vuepak Helped 20 Manufacturers to Package for Greater Sales	X500-6	Thalid for impression molding. Data sheet
F	Monsanto Plastics in Packaging	X800-1	Resimene 803-A Black. Melamine molding material
G	Monsanto Plastics in Toys	X800-2	Resimene 801-K — Specifications. Molding laminating resin
X100-1	Monsanto potting compound	X800-4	Resimene 840 — Melamine plywood adhesive
X100-2	Monsanto casting sealant	X800-5	Resimene 803-A — General
X200-1	Molding of Cerex	X800-6	Resimene molding compounds and resins
X200-2	Cerex data sheet	1000-1	Monsanto vinyl butyral
X200-3	Cerex—Applications	1000-3	Application of vinyl butyral
X300-1	Styramic HT (polydichlorostyrene)		

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SERVING INDUSTRY...WHICH SERVES MANKIND

MONSANTO CHEMICAL COMPANY, Plastics Division
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☐ A	☐ F	☐ X200-2	☐ X500-4	☐ X800-4
☐ B	☐ G	☐ X200-3	☐ X500-5	☐ X800-5
☐ C	☐ X100-1	☐ X300-1	☐ X500-6	☐ X800-6
☐ D	☐ X100-2	☐ X400-1	☐ X800-1	☐ 1000-1
☐ E	☐ X200-1	☐ X500-1	☐ X800-2	☐ 1000-3

*Name*_____

*Company*_____

*Address*_____

TONY'S ONE OF US!

Tony's job, like ours, is to help his customers get the maximum amount of service and good performance from difficult-to-replace investments! The thin but highly protective coating which Tony's applies to each pair of shoes, and the gleam produced by his effort is adding many an extra step to hard-pressed, war-rationed footwear!

In like manner we serve hard-to-replace dies, molds, machine parts. The coating we apply to their working surfaces—is a shell of hard chromium—no thicker than a hair's breadth but twice as hard as steel! Parts, so protected, stand up to the toughest production assignments—resist wear, corrosion . . . never stick . . . and won't accumulate dirt, grit or material excesses! Furthermore, our technique in no way disturbs the element of dimensional accuracies. We keep within closest established tolerances.

To insure the longest possible service from your dies—start with one that's now ready to leave the tool room bench—and let an I.H.C.* representative help you give it the right start toward a long and useful life! Inquiries invited.

INDUSTRIAL HARD CHROMIUM CO.

"Armorplate for Industry"

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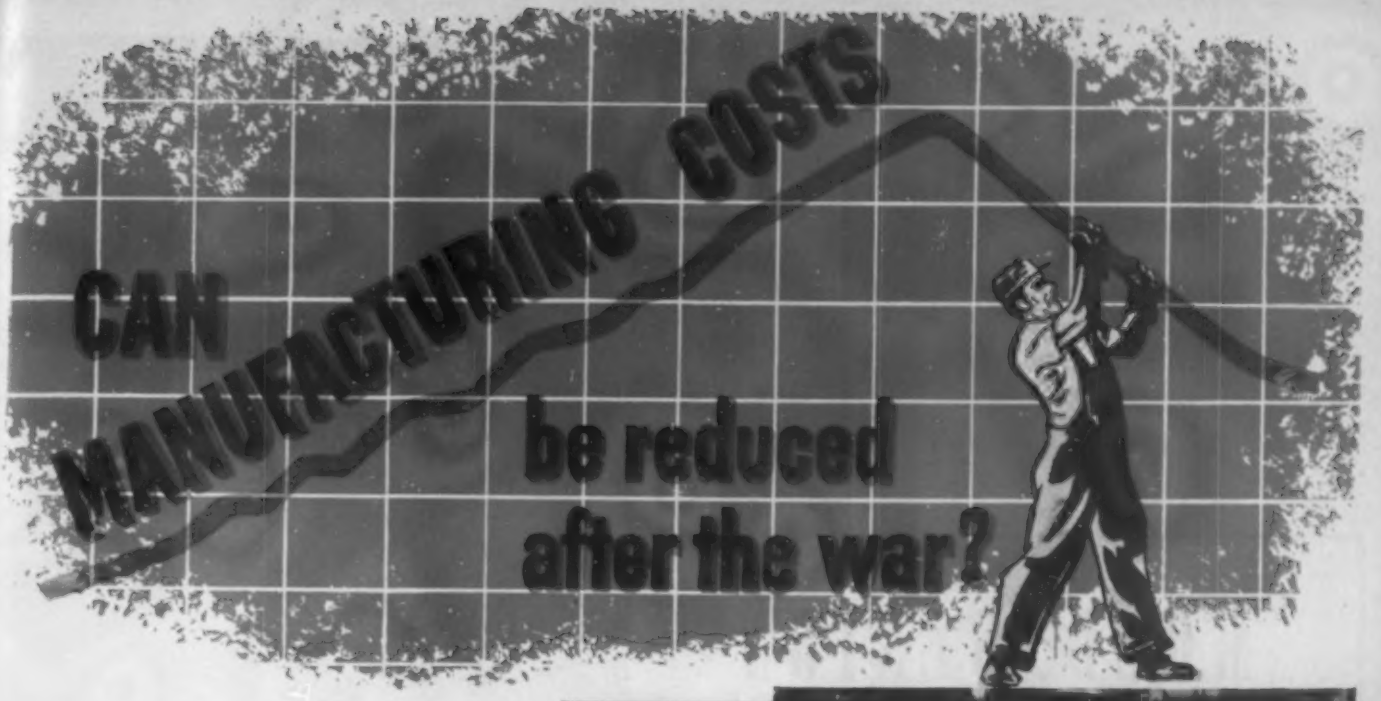


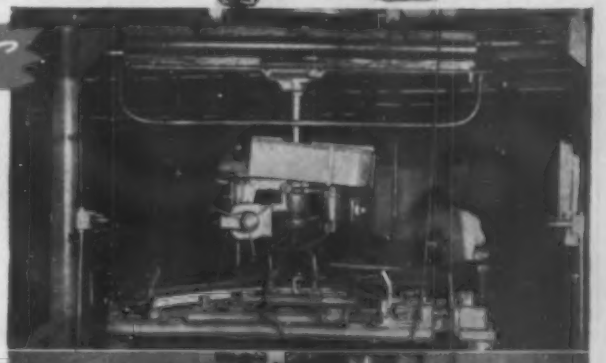
Walker-Turner Machine Tools have effected remarkable savings in war plants. Their wide range of operating speeds permits selection of optimum (most economical) cutting speed for every material. Simple, easy operation makes every man-hour more productive. Streamlined flexibility permits economical tooling set-ups. Low price and low power consumption keep capital investment and operating costs at a minimum.

Use Walker-Turner Machine Tools for the many jobs within their range and reserve heavy equipment for heavier work.

Walker-Turner Co., Inc., Plainfield, N. J.

METALS

Fast positioning and wide range of speeds make W-T Radial Drills ideal for this job at the plant of a large aircraft builder.



WOOD

W-T Radial Saw cross-cuts, rips, dadoes, miters, routs, tenons, Also available in metal-cutting model.

PLASTICS

Speed range from 61 to 5300 s.f.m. in this W-T Band Saw cutting Plexiglas bomber nose at Rohm & Haas

CERAMICS

W-T 15" Drill Press has high speeds and spindle stability for fine drilling at General Ceramics plant.

walker-Turner COMPANY, INC. PLAINFIELD, N.J. U.S.A.

MACHINE TOOLS

DRILL PRESSES — HAND AND POWER FEED • RADIAL DRILLS
METAL-CUTTING BAND SAWS • POLISHING LATHES • FLEXIBLE SHAFT MACHINES
RADIAL CUT-OFF MACHINES FOR METAL • MOTORS • BELT & DISC SURFACERS

Students learning mold design in a drafting class at Plastic Institute.

MOLD DESIGN

another important feature of practical training by

PLASTICS INDUSTRIES TECHNICAL INSTITUTE

THE mold design training for engineering students at Plastics Institute focuses attention on the basic principles of compression, transfer and injection molding. Problems are assigned to emphasize important mold design practices, including split cavity dies, side coring members involving the use of angle pins, automatic unthreading devices, racks and pinions. In the advanced work the engineering student prepares layouts of multiple cavity molds for various articles. Students also work upon DME mold bases, and extrusion tubing dies. The board work is accompanied by reference to the molds and machines are maintained for student practice in the molding department.

In addition to comprehensive training in mold design, every other phase of plastics is thoroughly covered at Plastics Institute. High-frequency pre-heating, low-pressure laminating, marketing and merchandising are among the newer subjects in the curriculum.

The value of *complete* instruction and training has been proved time and again by our many graduates the world over who have been successful in the plastics industry. We welcome your inquiries regarding resident training and the home study course.

Plastics
INDUSTRIES TECHNICAL
INSTITUTE

Francis A. Gudger, President - John Delmonte, Technical Director

For information write Dept. MP-4

122 EAST 42ND ST., NEW YORK 17, N. Y. ★ 221 NORTH LA SALLE ST., CHICAGO 1, ILL. ★ 1609 SOUTH WESTERN AVE., LOS ANGELES 6, CALIF.

The Case of the Stubborn Customer

Soon after the United States got into this war, materials were so short that many people rushed pell-mell into plastics. You may remember this period of panic and some of its horrible examples in the way of misapplications.

We well recall one manufacturer who came to us with an idea of substituting a plastic material for the brass which he had formerly used. His requirements were large — he could use many, many miles of plastics extrusions.

However, Macoid questioned the utility of his proposed application. We asked whether or not he had tested the plastic. The manufacturer told us that time was of the essence and he could not waste it on any tests.

We turned down the job, giving as our reason the opinion that the plastic was not suitable for the application. Later, this manufacturer found out at his own expense—and a considerable expense it was—that our advice had been correct.

We tell this story not in a "I told you so" manner, but rather to point out the way we do business. Macoid has built up an enviable record for successful extrusions of plastic materials. One reason is that we will not produce extrusions of materials that may not work out, just to make an immediate profit.

We also do injection molding

DETROIT MACOID CORPORATION

12340 Cloverdale Ave.
Detroit, Michigan

SOCIETY OF THE PLASTICS INDUSTRY · SPI

ORIGINATORS OF
DRY PROCESS PLASTIC EXTRUSION

Another proving ground for plastics

One of the largest producers of phenolic resins uses this 200 ton Lake Erie Hydraulic Press to prove under actual manufacturing conditions the qualities of their molding compounds.

From it has come many of the advancements in product development and methods of molding the versatile materials which they supply to other manufacturers.

Realizing the great future of plastics Lake Erie engineers have made a thorough study of all types of fabricating methods. Already we have designed standard compression molding presses that can be adapted to your needs —or we can build presses to meet any special production methods you may require. Write for complete information.

LAKE ERIE ENGINEERING CORP.
868 Woodward Avenue
Buffalo 17, N. Y.

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FOR MOLDING

• Our plant is located in the industrial heart of Ohio. Over 75% of all industrial production is within a 500-mile radius. That's another INTERNATIONAL shipping advantage for you. We are nicely equipped for more production on small parts in large volume. That includes knobs, handles, control buttons, switch cases, trays, appliance fittings and similar moldings. We specialize in compression type moldings with automatic controls. In submitting your problem, kindly supply blueprints and engineering details.

International Molded Plastics INC.

4387 WEST 35TH STREET, CLEVELAND 9, OHIO

Within the makeup of this giant, force and refinement are in harmony. Surface pressures up to 2000 pounds per square inch are exerted and yet the deflection on any of the mirror finish plates does not exceed five-thousandths of an inch.

To successfully associate extremes of this nature in such a massive unit comes only from skill and experience. When you need heavy machinery (large or small units) consult with Baldwin *first!* The Baldwin Locomotive Works, Baldwin Southwark Division, Philadelphia, Pa., U. S. A. Offices: Philadelphia, New York, Chicago, Washington, Boston, Cleveland, St. Louis, San Francisco, Houston, Pittsburgh.

Hydraulic presses, Testing equipment, Steel forgings and castings, Diesel-electric locomotives, Diesel engines, Metal plate fabrication, Rolled steel rings, Bronze castings, Heavy machine work, Crane wheels, Bending rolls, Plate planers, Babbitt metal, Alloy iron castings, Briquetting presses.

BLW THE BALDWIN GROUP **BALDWIN**

HYDRAULIC PRESSES

1.

Can Plastic Molding improve your product?

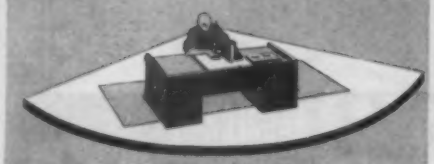
2.

Your Plastic Part should be molded of . . . What?

3.

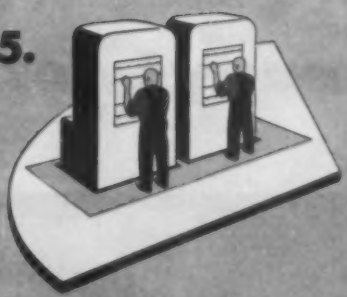
What goes into Plastic Design?

4.



Where should your Mold be made?

5.

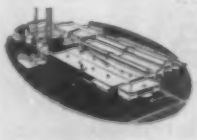


Considerations of Plastic Production

6.

What to look for —and why—in your Custom Molder

Our new illustrated brochure "A Businessman's Guide to the Molding of Plastics" discusses all those topics—and others. For engineers and purchasing departments, some technical data is included, along with a description of the resources and physical equipment we devote to producing better plastic moldings. If you are interested in this brochure, please write our Dept. 7 and request it *on your letterhead.* Your copy will be mailed promptly—with our compliments.



Kurz-Kasch

For over 28 years Planners and Molders in Plastics

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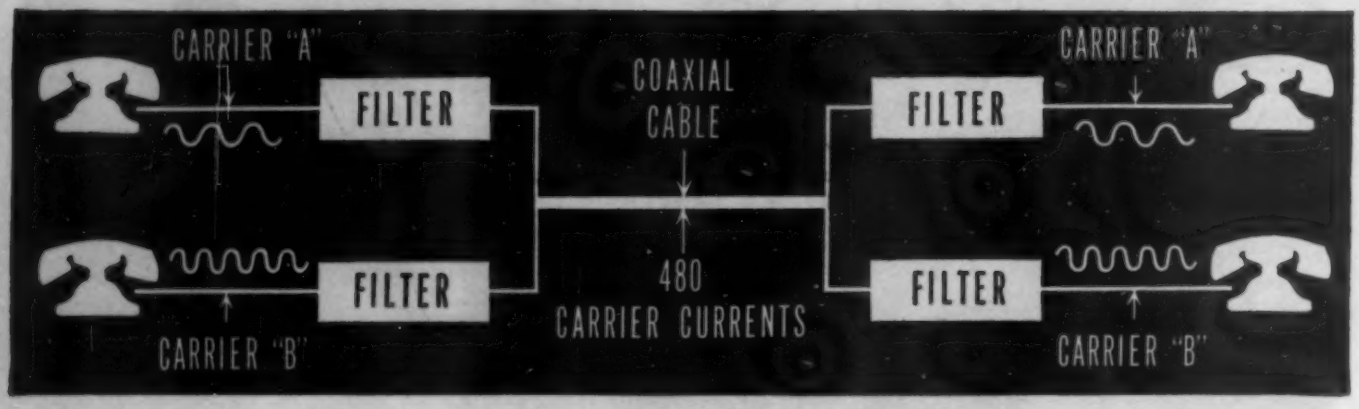
Crystal gateways for your voice



Four hundred and eighty telephone conversations over a coaxial cable was one of the last peacetime achievements of communication research in Bell Telephone Laboratories. In this multi-channel telephone system, each conversation is transported by its own high-frequency carrier current. At each end of the line are crystal gateways; each opens in response to its own particular "carrier" with the message it transports. In telephone terminology, these gateways are filters.

The ultra-selective characteristic of these filters is made possible by piezo-electric quartz plates, cut in a special manner from the mother crystal, and mounted in vacuum. Each set of plates is precisely adjusted so that the filter responds only to the frequency of its assigned channel, rejecting all others. In the coaxial terminal equipment, such crystal gates sort out messages for delivery to their four hundred and eighty individual destinations.

In recent years, Bell Telephone Laboratories research has provided the Armed Forces with many types of electrical equipment in which frequency is controlled by quartz crystals. Notable is the tank radio set which enables a tank crew to communicate over any one of 80 different transmission frequency channels by simply plugging in the appropriate crystal. The future holds rich possibilities for the use of quartz crystals in Bell System telephone service.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for our Armed Forces at war and for continued improvements and economies in telephone service.

SPEAKING OF THE FUTURE ...And of the Present... Practical and Important developments in RESIN FIBRE PLASTICS have already proven their versatility and wide range of application in services rendered on all our fighting fronts. To mention one specific contribution, are the diaphragms shown in the illustrations, which are a vital part of the now famous "Walkie-Talkie" radio transmitter and receiver, and many other types of communications equipment. Another merit-proven example of the versatility of RESIN FIBRE PLASTICS... A specific plastic designed for specific service conditions . . . helping speed the day of victory, to fulfill the tasks of the future.

THE PRESENT USE OF THE FUTURE

Millions of these and similar diaphragms have been produced by Hawley Products Company for use in Communication Equipment for the Armed Forces, that are today standard equipment in planes, tanks, ships, and many other communication requirements.

Action in South Pacific. Signal man in foreground keeps in close contact with BN.C.P. as he gives a blow account of tank battle.

MOULDED FIBRE PRODUCTS

Hawley

RESIN FIBRE PLASTICS

PRODUCTS COMPANY

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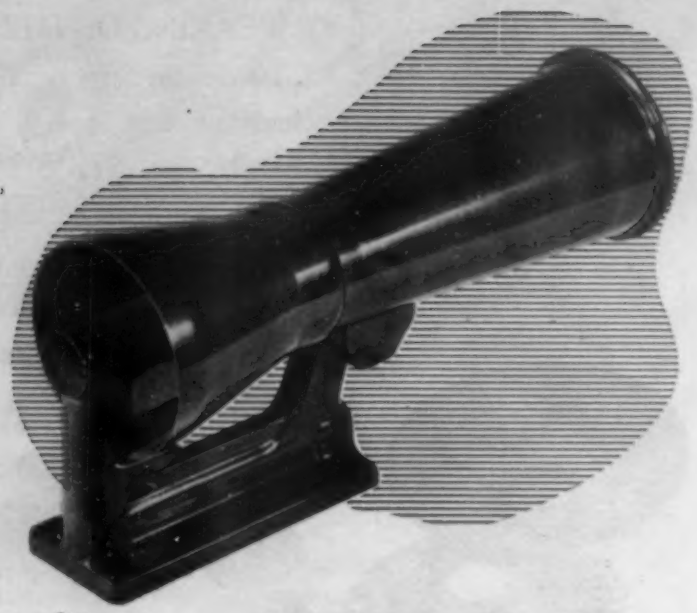
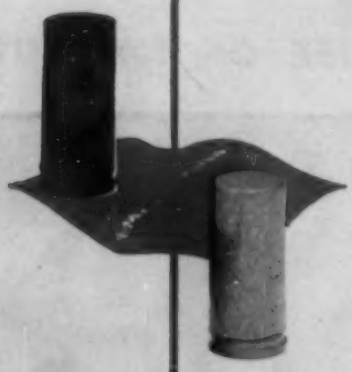
Plastics



For wing tips



and *Ladies Lips*

We could not think of two items further apart than the Venturi tube and the lipstick containers, both molded in our plant, to tell you of the versatility of our production.

Cruver was among the first in plastics to go all out for war. Among the many items that we have engineered and produced is the Venturi tube which illustrates as well as any, the finest precision molding and accurate, reliable assembly. This job is engineered in plastics to replace metal, simplify production and cut costs. Many thousands are flying on the tips of U. S. glider wings, activating bank and turn instruments and helping to bring the ships into safe landings.

The lipstick containers are typical of our mass production jobs for civilian markets. Injection molded like the Venturi, they offer precision fit at extremely low cost. They are inexpensive enough to allow the finished product to be sold via the 5 & 10 stores. Literally millions of these lipstick containers are being produced for a very famous name in cosmetics.

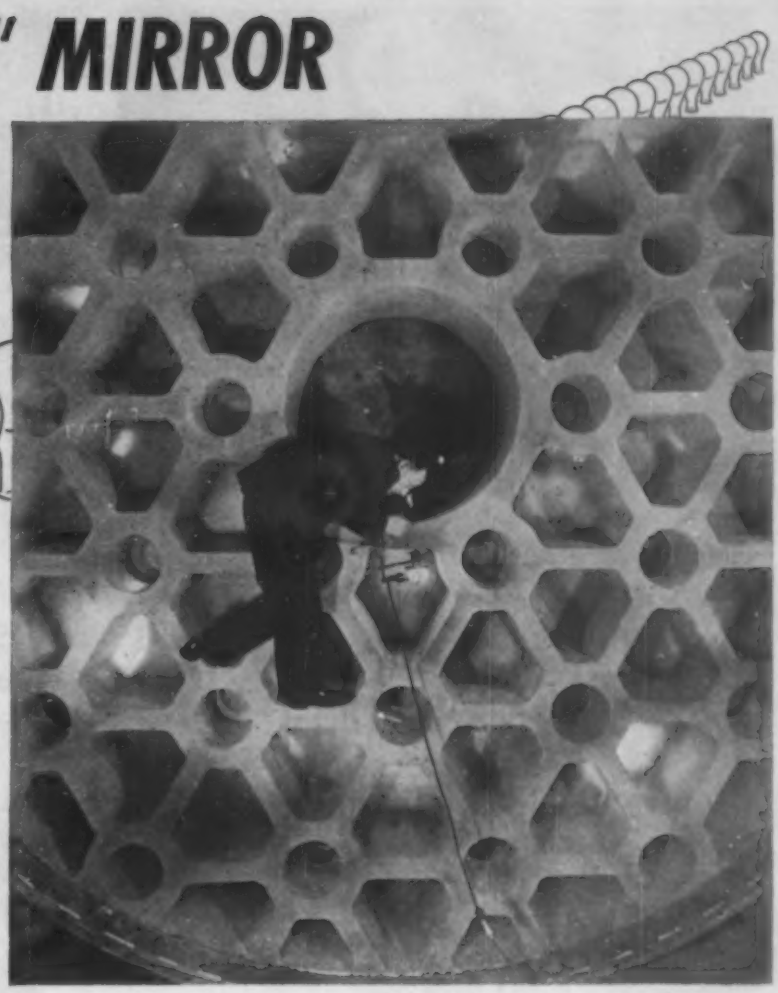
No matter what your plastics requirements, Cruver offers a flexible production service to meet it.

Cruver MANUFACTURING COMPANY

2456 W. Jackson Blvd., Chicago, Ill.

New York N. Y. | **Washington D. C.** | **Detroit Mich.**

FROM ONE 200" MIRROR TO BILLIONS OF LIGHT BULBS



Corning physicist examining ribbed structure of 200" mirror with polariscope.

SINCE the time it produced the glass bulb for Thomas A. Edison's first electric light in 1879, Corning has been supplying bulbs to nearly every manufacturer of electric light bulbs in America. To date billions have been manufactured on high speed automatic machines that produce them at the rate of hundreds per minute.

Here is a mass production process that turns out huge quantities of a glass product at a fraction of a cent apiece. Yet, significantly, it was the same facilities, the same engineering skill that produced the largest single piece of glass ever made—the 200" Mt. Palomar Telescope Mirror.

Only Corning has these facilities that can produce a single piece of glassware for a very special application and where cost is no consideration . . . or a million pieces made on Corning designed high speed machinery at quantity production prices. In developing new products and in redesigning you can be sure of finding at Corning the glass knowledge, the "know-how," and manufacturing facilities for meeting your requirements with glass. With thousands of glass formulae from which to choose, with the engineering skill to turn out glass parts economically, Corning may provide a solution to your problems. It will pay you to consult Corning Engineers. Write now. *Industrial Sales Dept. MP-4.*

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CORNING, NEW YORK

CORNING *means* Research in Glass

INDUSTRIAL GLASS by CORNING

INDUSTRIAL SALES DEPT., MP-4—
Corning Glass Works, Corning, New York

Please send me a copy of your Bulletin 842—
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Long-Lasting! Glycerine is an important raw material in the making of alkyd resins, used in modern "war paints." It helps to make such paints quick-drying, tough, long-lasting.

Safe in Medicines! Glycerine, the versatile solvent, carrier, humectant, is used in many pharmaceuticals because it has been proved *safe*. Use glycerine in your products.

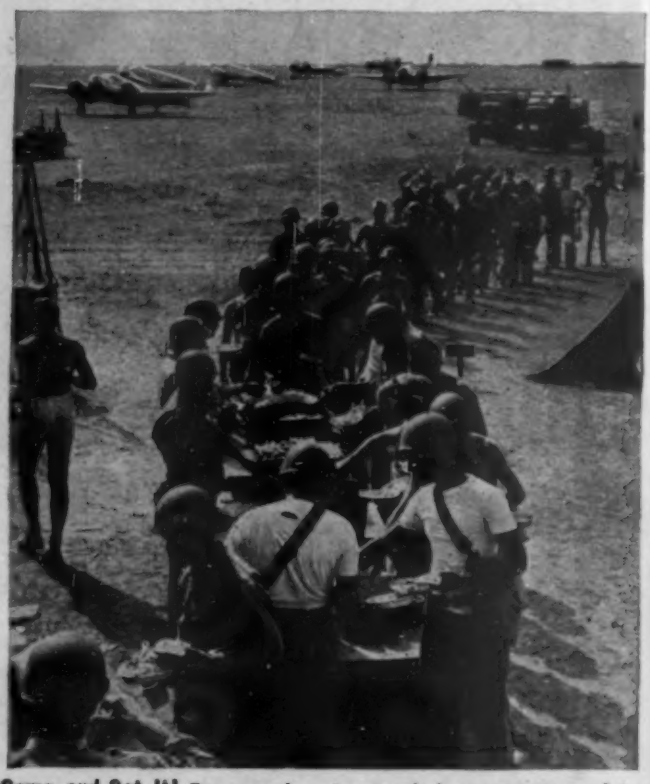
GLYCERINE,

Key War Material, Now Available for Civilian Goods!

GLYCERINE, time-tested ingredient depended upon by so many American manufacturers, is now off allocation! War needs have been huge, but today there is glycerine for the production of civilian goods!

Nothing takes the place of glycerine in many vital war materials. The Surgeon General's Office and the Medical Corps recognize the necessity of using wholesome glycerine in the making of many medicines, and in other instances where human life is concerned.

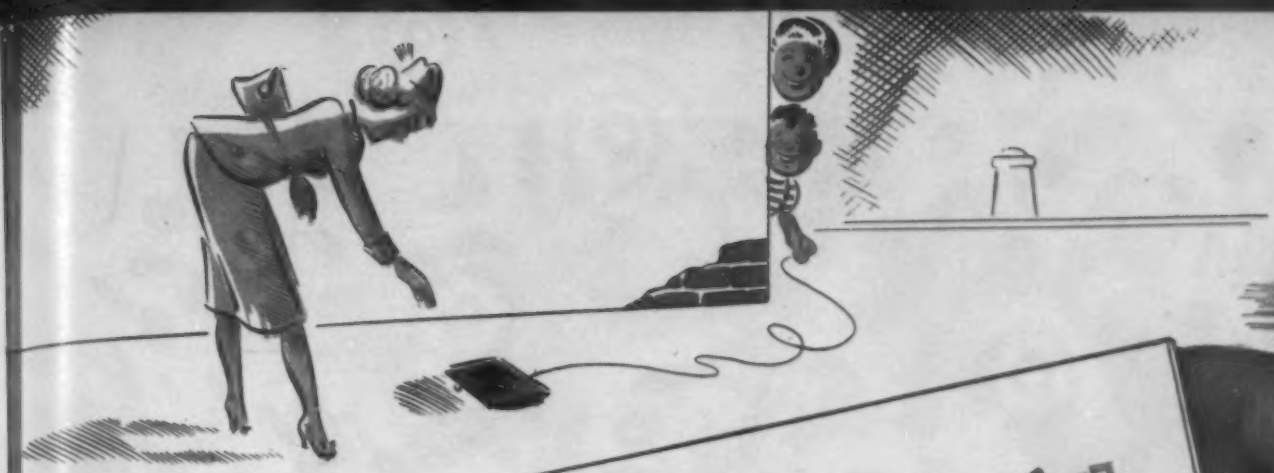
If you have been using emergency substitutes, you'll want to get back to safe, time-proven glycerine. And in planning new products, you'll want to use glycerine, too. Send for the free booklet, "Nothing Takes the Place of Glycerine — 1583 Ways to Use It." Address: Glycerine Producers' Association, 295 Madison Avenue, New York 17, N. Y. Dept. J-5.



Come and Get It! Because glycerine is wholesome, it is used in foods and food products — in sausage casings, in chewing gum, candies, flavorings, and colorings. Use glycerine!

More Satisfaction! Most cigarette tobaccos are kept from drying out through the use of glycerine. Use time-tested glycerine as the moistening agent in your products—*and be sure!*

More Business for You! If you are using emergency substitutes, you can now get back to safe, time-tested glycerine. And when you plan new products, you'll want to use glycerine, too!



NORTON LABORATORIES (INCORPORATED)

CUSTOM MOULDERS OF SYNTHETIC PLASTICS
BAKELITE DUREZ

LOCKPORT, N.Y.

NORLOC NOVELTIES

ALL AGREEMENTS ARE CONTINGENT UPON STRIKES, FIRES, ACCIDENTS OR CAUSES BEYOND OUR CONTROL.
CONTRACTS WITH AGENTS NOT VALID UNTIL APPROVED BY AN OFFICER

April, 1944

Dear Plastics User:-

50,000 plastic parts on a battleship! 1,000 plastic parts on a Navy bomber! A few years ago, statements like these would have been April Fool stories. But not today - as you well know (the figures quoted above come from the January issue of MODERN PLASTICS).

You can see how far plastics have advanced since the war when you realize that most of the applications which go to make up these totals are new since Pearl Harbor. You can get an idea of how far plastics have advanced in the esteem of all the industries which contribute to building war equipment when you realize that many of them have become acquainted with plastics only since Pearl Harbor.

None of them, of course, are going to forget their war-time experiences. They are all now sold on plastics and of course, we of the plastics industry expect to be called on to keep the flow of plastics parts going.

We don't have any definite idea of all of the new applications in which plastics will be used, but we do know that the materials have proven themselves to the satisfaction of everyone. And we aim to continue to mold them to close tolerances and other exacting standards set for us by customers

Sincerely yours,

Cecil Clack

CECIL CLACK
FINISHING SUPERINTENDENT

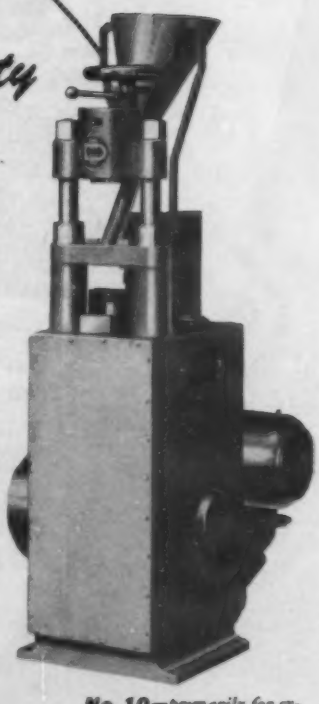
PLASTIC PREFORMS

at High Speed with Uniformity

★ Start your plastic pill production *right*—for *today and tomorrow*—with Defiance Plastic Preforming Machines! Highly versatile—these machines designed to produce tablets in a *wide variety of shapes and sizes* to meet growing demands for plastics. Weights of preforms can be rapidly changed—without even stopping the machines. Tools can be quickly interchanged.

Cleanliness in operation assured with material leakage reduced to a minimum. Easy to change colors. Less "down time" for cleaning. Exclusive features of Defiance design mean *greater uniformity in weight and density*—with high speed production—and utmost dependability. Write for more facts. Defiance Machine Works, Inc., Defiance, Ohio.

***No. 20**—for large pills and wide range of shapes and sizes; withstands 100-ton preforming load.*



***No. 10**—primarily for cylindrical shapes, either solid or perforated; withstands 25-ton preforming load.*

DEFIANCE

Plastic Preforming Presses

TOUGH STUFF FOR ROUGH STUFF

"HEY, CUT IT OUT! Don't throw that water!" . . . Rough stuff in the rumpus room has frayed many a parent's nerves. But thanks to VINYLITE plastics, there's upholstery today that stays unfrayed through countless riots—and even keeps on *looking new!*

Tough stuff, this VINYLITE plastic upholstery! It wears as upholstery never wore before. Old age doesn't crack it. Grease can't affect it. You never have to worry about its soiling, for it is readily cleaned with a damp, soapy cloth. In short, upholstery fabric coated with VINYLITE plastic compound brings degrees of wear resistance, long life, and untroubled service never before attained. And it's a *quality* material, at home among the choicest textiles and the most discriminating surroundings. It can be produced in desired colors, in unusual surface effects, and with the rich texture of fine leathers.

Today, VINYLITE plastic upholstery is demonstrating its outstanding wear and toughness in jeeps, planes and tanks. In days to come it will take its place as the superlative material for home and office furniture, motor cars and motor boats, buses, and other peacetime applications.

Specify VINYLITE plastic upholstery for essential uses *now*. Write Department 7 for technical assistance and detailed information.

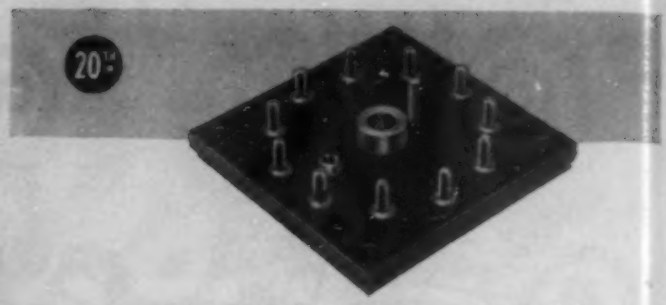
BAKELITE CORPORATION
Unit of
Union Carbide and Carbon Corporation
UCC
30 EAST 42ND STREET, NEW YORK 17, N.Y.

Vinylite Plastics

TRADE-MARK

Aico

PRECISION MOLDED FOR ACCURACY



Tap Switch Plate Makes "GOOD CONNECTIONS"

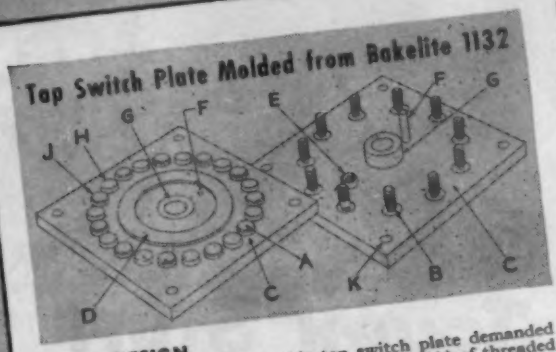
HERE'S an electrical part that has made "good connections" . . . with plastics . . . and with Aico.

This tap switch plate . . . used in X-ray equipment . . . is molded from plastics for extreme accuracy and dimensional stability over a long period of service. It contains 14 molded-in brass and steel inserts for providing electrical contacts and for assembly with other parts. This is another difficult molding job, successfully engineered by Aico's plastic experts.

At Aico, high skills and experience gained in 29 years of precision molding are "on tap" for the solution to all types of plastics problems.

BAKELITE 1132 TAP SWITCH PLATE

Tap Switch Plate Molded from Bakelite 1132



MOLD DESIGN
Exacting requirements for this tap switch plate demanded expert mold making. Dimensions from base (A) of threaded terminals (B) to flat surface of plate (C) must be extremely accurate. Circular brass insert (D) is partially imbedded in molded plate; tapped part (E) of insert extends through molded part. Steel inserts (F) and (G) are flush with contact side of plate (C). Bosses (H), alternating with metal contact buttons (J), are plastic. Holes (K) are for assembly.

MOLDING METHOD
The transfer method, used in molding this part, offers a paramount advantage in its suitability for molding parts with numerous inserts. The inserts can be held in place more accurately than in compression molding because the mold is closed when material enters. Minimum flash is produced by this method, thereby cutting finishing time on parts which require removal of all flash from inserts.

MOLDING MATERIAL
The molded plate must be perfectly flat because of electrical contacts. Proper wall thickness had to be determined to provide the fastest possible cure and, at the same time, provide sufficient anchorage for inserts. Bakelite 1132 provided the chemical and physical properties required. This material has good dimensional stability, is suitable for molding inserts and has a good surface finish.

**This is No. 20 in Aico's plastics applications series. Send a request on your letterhead for file cards Nos. 1 to 20.*

Aico

AICO

PRECISION MOLDING

29th Year

AMERICAN INSULATOR CORPORATION

NEW FREEDOM, PA. Sales Offices: Boston • Bridgeport • Cleveland
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Here's the Booklet we promised YOU!

The Story of SARA-SEAL *is now ready!*

THIS free booklet describes completely the principle and operation of the amazing machine which seals an almost limitless variety of products in moisture-proof, air-tight, floating bags of transparent plastic. It gives technical data on sealing methods and materials. A book for everyone interested in protective packaging. The coupon will bring your copy.

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MACHINE TOOL DIVISION

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Please send me a copy of your new Sara-Seal booklet.

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DEDICATED TO NEW HORIZONS SINCE 1865

IT WAS THE YEAR of 1865 that William Deering and Seth Milliken formed their partnership, founded upon sound principles of service, and with a vision that has expanded and enlarged many fold in the 80 intervening years.

During these 80 years the Deering Milliken mills have rendered an essential and ever expanding service in peace and in war, producing cottons, woolens and rayons for civilian and military needs.

Today our entire efforts are devoted to the winning of the war. When victory has been won we will again turn our energies to the production of the finest fabrics we are able to style for civilian requirements.

For it is traditional that this company should today be blazing the trail for better fabrics on tomorrow's peaceful horizons.

Eightieth Anniversary

Woolen Sales Office:
450 Seventh Avenue

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DEERING MILLIKEN & CO., INC.

240 CHURCH STREET, NEW YORK, N. Y.

Los Angeles Sales Office:
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PACOLET MFG. CO. (Pacolet Plant, New Holland Plant, Gainesville Plant)
DRAYTON MILLS • DALLAS MFG. CO.

AT NORTHWEST *Plastics*

WE'RE LOOKING AHEAD!

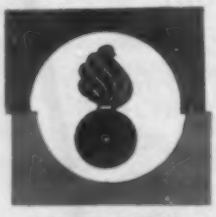
Our special transfer molds of three to twelve cavities which are used with special transfer presses are designed to provide a method for maintaining molding pressure on the piece while the mold is removed from the press, and curing is completed in an oven. This technique, in rubber molding for example, permits a press to handle twenty molds per hour as against two molds per hour with conventional methods. The same cure time will be maintained on each mold, but this one press is now doing the work of ten.

The method provides an opportunity to reduce unit costs substantially on small quantity orders without involving the higher costs of large multiple cavity molds.

This technique further provides a method for sharply reducing the amount of flash cleaning usually required. With this method close tolerances are easily held and the quality of the molded pieces maintained at a consistently high level.

Our services are at your disposal to assist you with your molding problems. Write us today for complete information. Northwest Plastics Incorporated, 2233 University Ave., St. Paul 4, Minn.

ARMY ORDNANCE AWARD



FOR MERITORIOUS PRODUCTION

Compression molding • *Transfer molding* • *Injection molding* • *Extrusion molding*
Modern Tool and Die Department • *Finishing, Fabricating and Assembling Department*
Laboratory for Development and Production Control • *Engineering and Product Design*

SOCIETY OF THE PLASTICS INDUSTRY

NORTHWEST PLASTICS inc.

IT COSTS NOTHING TO INQUIRE *but a* LOT *to* EXPLORE!

Perhaps we've already developed the very derivative you need

A reserve of new low molecular weight mono and dibasic acids and their esters is waiting in our research laboratories to help solve new problems. The press of wartime production has, in many cases, hastened the development of these new products. But it has also delayed their announcement, and halted as well an active search on our part for the multitude of possible peacetime applications that will exist.

Many of these new products offer particular promise to the plastics industry. It is entirely probable that the very compound you need to perfect some new elastomer—to improve one of your present products or facilitate its more economical processing may be lying in the Emery reserve unannounced.

A letter explaining your problem may save you a great deal of money and time.

Two EMERY DEVELOPMENTS

L110 AZELAIC ACID

$C_7H_{14}(COOH)_2$

Melting Point.....90°C
Combining weight.....93-95
Solubility (water) ∞ @ 100°C
Solubility (alcohol) slight @ 25°C

EMERY'S PLASTICIZER X-55

A glycol ester of pelargonic ($C_8H_{14}COOH$) acid is compatible with a wide variety of resins including nitrocellulose, other cellulose-base plastics, and many of the vinyls. To these it imparts good low temperature plasticity.

EMERY INDUSTRIES, Inc.

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MODERN PLASTICS
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A new way of using old materials

by JOHN DELMONTE*

COMPOSITE laminates are prepared from sheets of two or more materials united with the aid of resin adhesives. They may be comprised of metals, cellulosic insulating boards, ceramics, textiles, woods, papers, rubbers, pulps, cork, vulcanized fibre, glass, organic plastics, and other materials available in a flat or a laminar form. Regardless of the combination of materials, the quality, appearance and serviceability of the laminate are dependent upon the ability of plastics to bond dissimilar materials and protect surfaces by the formation of impervious films.

Decorative laminates

The first decorative and functional laminates to attain commercial importance were the sheets of laminated phenolic or laminated urea plastics now encountered on table tops, bars and counters throughout the country. They are decorative in that attractive designs and colors are skillfully integrated into the body of the laminate; functional in that their surfaces will resist the effects of alcoholic beverages and withstand a certain amount of heat due to the presence of a thin laminar of foraminous heat-conducting metal near the surface. These laminated sheets are cemented to a plywood base at the time of assembly.

Today there are more economical methods of preparing decorative laminates with a core material of plywood veneers and a relatively thin face of plastic sheet for protective and decorative purposes. The thin surfacing sheet may be a continuous film of plastic—a cellulose derivative bonded into place—a resin-impregnated paper or textile. Colored textile prints impregnated with urea- or melamine-formaldehyde resin may, for example, be hot pressed at low pressures into the face of the plywood. In the case of the panels shown in Fig. 2, single sheets of cloth were pressed onto the face of an inferior grade of Douglas fir plywood to give a surface with the hard, scratch-resistant properties which are characteristic of melamine laminates.

It is not always necessary to assemble resin-impregnated sheets to completed plywood. Sometimes it is more expedient to press the resin-impregnated skin into place at the time the plywood is laminated. Under these conditions, if the resin content is sufficiently high—say, 55 to 60 percent—the plastic may be expected to fulfill the dual rôle of impregnant and binder.

There is, too, the development of custom-made decorative laminates from plywood—a new outlet for plastics in the building material trades. With this development, interior decorators may specify the lamination of selected colored prints onto special plastic-faced plywood.

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A few years ago, thin sheets of phenolic-resin impregnated papers were shown to develop excellent moisture barriers for plywood (1).[1] In Fig. 8 the rate of diffusion into the plywood may be ascertained from the initial slope of the time-deflection curves. Measurements were made upon simple cantilever beams with one surface exposed to water and one surface fully protected by metal foil. Improved measurements have been obtained, particularly where the thin surfacing paper was a high-strength Mitscherlich pulp. Physical properties of the laminates were found to improve in direct relationship to the ratio of paper laminate on the surface to the plywood core.

As far as the practical aspects of the use of phenolic-resin impregnated papers on plywood surfaces are concerned, it has been claimed (2) that plastic-faced plywood shipping cases have about one-twentieth the water absorption of the conventional "waterproof" plywoods. Formed into composite laminates the material is ideal for shipping vital war material overseas. In some instances a loosely matted fibrous resin sheet with a thermosetting resin diffused throughout may be preferred to the high-strength paper (3).

It is not always necessary to hot-press resin-impregnated papers and cloths into the face of plywood. Equally desirable effects may be obtained by cementing finished sheets of thermosetting or thermoplastic materials to a plywood base by means of resin adhesives. For example, the application of a cast phenolic sheet to a plywood base (top, Fig. 4) not only reinforces the relatively brittle cast phenolic, but also enhances the appearance of the finished assembly. Similarly, laminated phenolic, Grade X or Grade C sheet, may be cemented to a wooden core or a core of Masonite diestock. The latter assembly offers a particularly effective combination

[1] Numbers in parentheses refer to the bibliography.

Composite laminates may be prepared for decorative purposes using an inexpensive core material surfaced with an attractive plastic. Or they may be made up for such functional purposes as require superior strength-weight characteristics. In this article only the more important combinations can be considered and their techniques evaluated so that others in the plastics industry may benefit from early work in this field.

PHOTO, COURTESY FORMICA INSULATION CO.

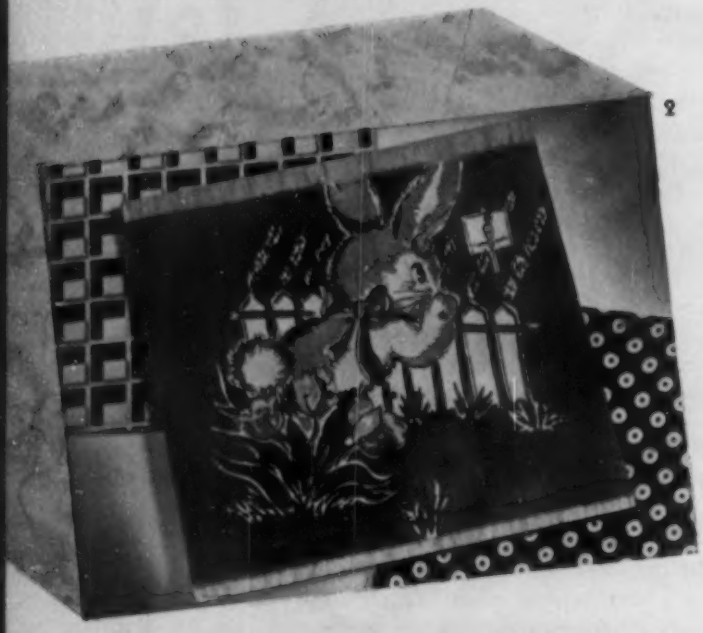


PHOTO NO. 3, COURTESY C-W PLYWOOD CO.

inasmuch as it gives to the tough, durable Masonite diestock (costing approximately 10 cents a pound) a hard working face of laminated phenolic plastic (costing about 70 cents per pound). The special advantages of both materials, brought out in the composite laminate (the lower section of Fig. 4) make it admirably suited for aircraft tooling, specialty jigs and fixtures. Methods of assembly are listed in Table I.

TABLE I.—METHODS OF ASSEMBLY

Composite laminate	*Adhesive recommended*	*Pressing conditions*	*Surface preparations*
Wood to cast phenolic	Resorcinol-formaldehyde	Hot or cold	None
Wood to laminated phenolic	Furfural resin X-1	Hot or cold	Phenolic smooth
Masonite diestock to laminated phenolic	Furfural resin X-1	Hot or cold	Masonite sanded slightly
Cellulose derivative to wood	Polyvinyl acetate	Hot	None

Thermoplastic sheets faced on plywood afford a wide variety of decorative composite laminates depending upon the type of design present on the plastic sheet. Cellulose derivatives—mottled or with every conceivable color combination applied in variegated, dotted or striped patterns—have been prepared and lend themselves to use as construction materials. The thickness of the surface laminate determines whether a stiff polished plate or simple mechanical clamps will be required for pressing. In some highly interesting experiments on sandwich materials, employing balsa and pulp-cores, Engel and Troxell (4) have shown that the greatest flexural stiffness for a given weight will have a core weighing approximately two-thirds of the total.

Various combinations of wood and thermoplastics have been made using alternate layers of both materials. W. H. Moss shows a preference for uniting layers of wood with relatively thick layers of thermoplastic material (5), the claim being that such construction simplifies the molding of the assemblies into aircraft structural parts. Assemblies involving wood veneers 0.001 to 0.04 in. thick were prepared, relatively high pressures and temperatures being employed to consolidate the assembly.

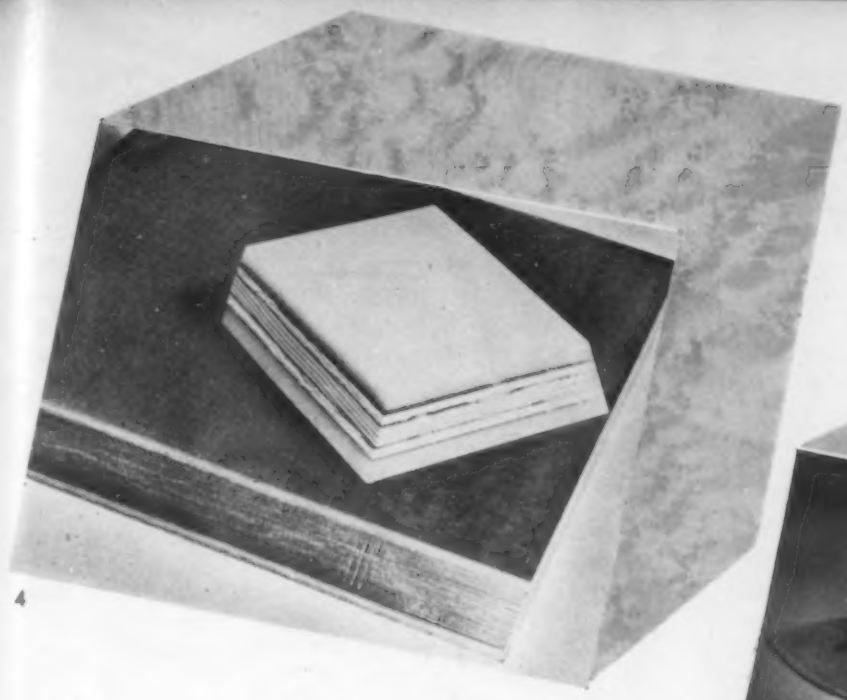
Alternate layers of cellulose derivatives and cloth yield thermoplastic laminates that are marked by a high degree of formability (Fig. 5). Tests have shown[2] that the properties of thermoplastic laminates are a function of the amount of plastic interleaved with the cloth during the preparation of the composite assembly (6). Typical data are shown in Table II for combinations of a lightweight Osnaburg cloth and cellulose acetate sheet.

Metal to wood assemblies

Considerable interest has been evinced in wood-metal assemblies because metal not only acts as an excellent moisture

[2] Tests performed at laboratory of John Delmonte in accordance with the applicable A.S.T.M. Specifications.

1—Sheets of laminated phenolic or urea plastics such as the material used for the top of this night table, were the first decorative and functional laminates to attain commercial importance. 2—Thin textile cloths were impregnated with resin and pressed into the surface of the plywood to form this laminate. 3—Composite laminates are much used in shipping cases for vital war matériel



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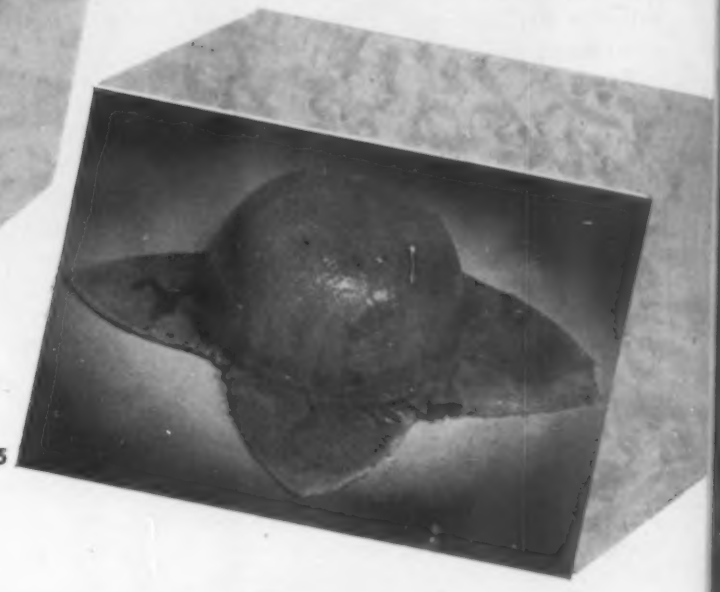
4—The top composite laminate combines cast phenolic and Douglas fir plywood; the bottom laminate is composed of a Grade C laminated phenolic and a Masonite diestock core. **5**—*This thermoplastic laminate was prepared from alternate layers of Osnaburg and cellulose acetate*



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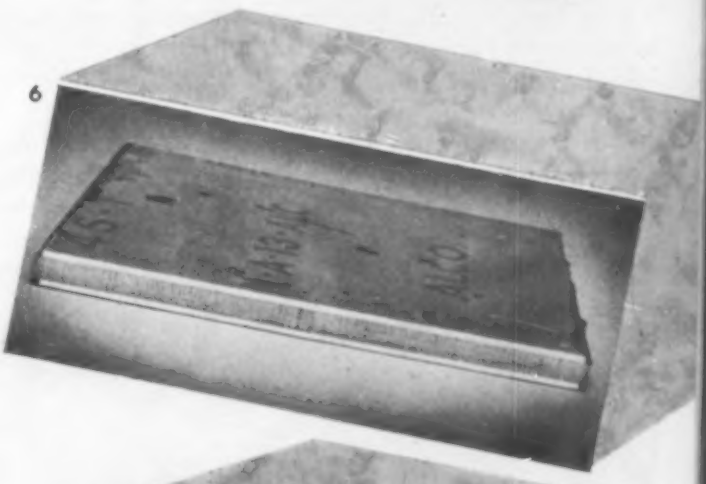
barrier but serves to strengthen the assembly. It has been found that the greatest strength-ratios are realized as the metal is removed from the neutral axis. Since the attainment of good specific adhesion to metal is not always easy, various prime coats may be recommended, to be followed by the application of other adhesives which bond to the prime coat and the wood. G. R. Ensminger recommended an alkyd resin for this purpose (7), while G. G. Havens and R. D. Ford suggested that a synthetic resin-rubber combination be used for the application (8).

One of the leading plywood manufacturers has found that plywood faced with a thin layer of light metal is excellent for use as a sheathing or exterior siding or roofing in prefabricated houses (9). M. Scholz and A. Wagenitz cemented a wire gauze to airplane propellers for stiffening purposes—the synthetic-resin adhesive layer effectively filling the meshes of the wire gauze (10). The Schwarz method of protecting wooden aircraft propellers with special wire gauze reinforcing strips—cellulose acetate being employed to consolidate the assembly (11)—also has special advantages. In the manufacture of compound plates of metal to plywood, the advantages of cold pressing the metal into place have been recognized (12). The explanation lies in the differences in thermal expansion and contraction of the two materials which may lead to the development of severe stresses during the heating and cooling period. To avoid the warping, it is generally necessary to maintain a balanced construction with metal on both sides of the layup.

A. Staeger has described a number of applications of metal-armored-plywood in electric and radio apparatus, switchboards, motor busses and electric trolleys (13). N. A. deBruyne developed a laminated structure involving a phenolic-resin impregnated fabric, which bonded firmly to a metal sheet (14). W. Luty also used phenolic resins to bond a perforated sheet metal to ply- (*Please turn to page 190*)



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6—*When metal is bonded to a material with considerably different thermal characteristics, cold-press assemblies are often preferred. Thus, this laminate which is made up of aluminum alloy and cast phenolic is bonded with cold-setting furfural resin adhesive.* **7**—*Laminated phenolics and acrylics, arranged in alternate layers, are bonded with cold-set furfural resin adhesive*

As the crow flies

by J. GORDON LIPPINCOTT*

DURING the latter part of 1944 in the city of Boston, a helicopter built by Aeronautical Products, Inc., made the first commercial delivery of merchandise from city to suburb—the start of a new mode of distribution which should enjoy wide popularity in the coming postwar period.

Because of its ability to hover over a given point, land on terrain not easily accessible by present transportation standards, and to rise and descend vertically, the helicopter should prove invaluable for many commercial purposes. In pipeline inspection through isolated and rugged sections of our country such a plane would allow repair crews to locate breaks, drop down with full equipment and make immediate repairs. Demands for helicopters can be expected from the forestry service as an aid in fire control and from farmers interested in more efficient methods for crop dusting. Transportation of airline passengers from airport to city offices is also well within the potentialities of the helicopter.

However, before any volume in helicopter sales is reached, the manufacturers have three problems to solve. They must make these planes safe to operate. They must make them easy to operate. They must make them economical to operate. And to sell in the mass market, helicopters must not only *be* safe but they must *appear* safe.

Early models of helicopters were somewhat skeleton-like in appearance, looking as if they might fall apart in a good swift wind. Recognizing that confidence in the safety and stability of the plane is a prerequisite of public acceptance, leading aircraft producers are making strikes toward development of helicopters that will be as trim, inside and out, as the modern automobile.

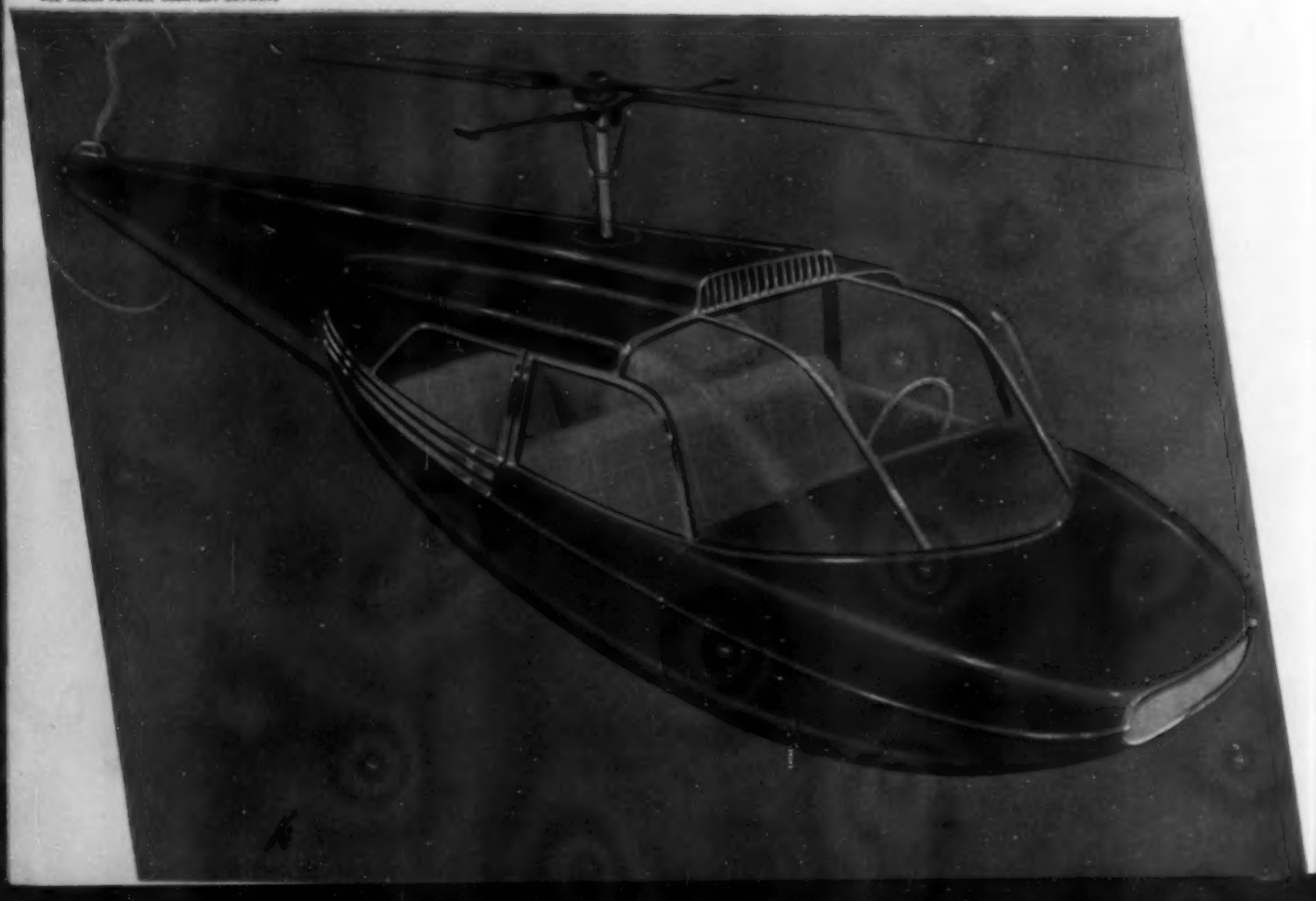
It is possible, in my opinion, that the fuselage of the postwar helicopter, in addition to being constructed of light metals, will feature low-pressure laminates produced from low- or contact-pressure resins reinforced with glass-fiber fabric or other materials. The transparent portion of the helicopter body will be an even more extensive user of plastics. Since these planes will be expected to land and take off from a relatively small area of space, visibility will be inseparable from safety. Helicopters can and should have "round-the-clock" visibility—and bomber noses, blisters and turrets have proved the practicability of transparent acrylic resin enclosures. Weight, which is of first importance in all aircraft, will make the use of clear acrylics almost imperative since those materials have about one-half the weight of plate glass and can be formed into compound curves with far greater facility. Furthermore, acrylics retain a high degree of transparency without yellowing or changing color.

In almost all civilian products color is an important sales factor. To secure a finish promising the ultimum in sales appeal and flexibility over a long life, I suggest a coating of phenolic dispersion or alkyd resins which will give the re-

* Dohner and Lippincott, Industrial designers.

***1**—The fuselage of the postwar helicopter may well feature low-pressure laminates produced from low- or contact-pressure resins reinforced with glass-fiber fabric or other materials. This proposed helicopter and all other designs featured in this article are the work of Dohner and Lippincott*

ALL COLOR PLATES, COURTESY SKYWAYS



2—For the sake of safety, helicopters should have "round-the-clock" visibility which will, in all probability, be provided by transparent acrylic resin enclosures similar to bomber noses

quired adhesion and resistance to moisture, oils, gasoline, acids, salt water and changes of temperature. The fact that the finish will not soften or lift because of subsequent applications is of particular importance, since civilians are prone to change their minds with regard to color.

Of necessity, many metal stamped parts will be used in helicopter construction and all will require a protective coating against corrosion and the elements. Even before incorporation in the plane, these metals may well be protected by plastics. When metal parts are stamped out, oil and grease are forced into the raw metal to reduce heat and friction. In order to restore the original condition of the metal it is necessary to clean the surface prior to assembly. However, it has been found that pretreatment of the metal with plastics before the stamping operation eliminates these cleaning operations and is faster, cheaper and more efficient. Vinyl copolymer resins are applied as a coating which is then baked at approximately 300° F. These resins cling well to the metals to form a protective, flexible coating. Regardless of what happens to the metal during stamping, the coating maintains a continuous protective flexible film.

To meet the demands of the postwar civilian market, helicopters must not only be safe—they must appear safe. Not only the exterior but the interior must inspire confidence. The fittings must be in keeping with customer expectancy and be tailored with the same good taste employed by automobile manufacturers. The durability, water- and weather-resistant qualities and easy-to-clean features of interior upholstering and seat covers woven from flame-resistant vinylidene-chloride fibers will be a strong selling point with potential customers. And, at the same time, the assorted colors and patterns in which materials of this substance are obtainable will add tremendously to the general appearance of the helicopter interior.

Vinyl chloride acetate and vinyl chloride are well suited for pipe-line flange gaskets, gaskets for sealing windshields and windows, grommets, floor coverings to replace rubber or fiber mats. Dials and dashboard accessories will undoubtedly take advantage of the properties of fluorescent laminates and acetates. Phosphorescent acetates and clear acrylics can provide edge lighting and add beauty to the instrument panel. Ureas, phenolics, acetates or styrenes may well be used for knobs, buttons and fittings.

In addition to being safe, and appearing so, helicopters must be easy to operate. The helicopter is difficult to pilot, and many fixed-wing pilots with thousands of hours of flying time to their credit cannot operate these rotary wing planes until checked out in 3 to 4 hours. Furthermore, it was generally conceded that the fatigue of flying a helicopter was much more pronounced than with the conventional planes because of the dissimilarity of control reaction and the greater number of controls. Another headache was noise.

Most of these "bugs" have been eliminated, and helicopter experts predict that in the future it may be easier to learn to fly a helicopter than a fixed-wing plane. Recent tests suggest that pilots may not have to fight the controls continuously but will be able to relax and really enjoy a helicopter rise. The engineers in the aircraft industry are developing a

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3—At least two factors will make the use of acrylics in the transparent portions of the postwar helicopter almost imperative. One is weight, for these plastics are about half as heavy as plate glass. The other factor is the ability of acrylics to retain a high degree of transparency without yellowing

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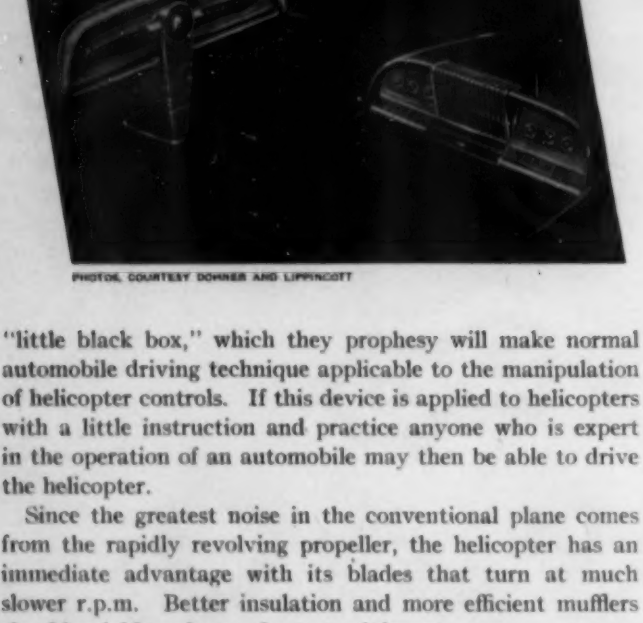
4—Leading aircraft producers are making strides toward the development of helicopters that will be as trim, inside and out, as the modern automobile. **5**—*It is important, if helicopters are to reach volume sales in the postwar period, that fittings meet with customer expectancy and be well tailored*



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PHOTOS, COURTESY DOHNER AND LIPPINCOTT

"little black box," which they prophesy will make normal automobile driving technique applicable to the manipulation of helicopter controls. If this device is applied to helicopters with a little instruction and practice anyone who is expert in the operation of an automobile may then be able to drive the helicopter.

Since the greatest noise in the conventional plane comes from the rapidly revolving propeller, the helicopter has an immediate advantage with its blades that turn at much slower r.p.m. Better insulation and more efficient mufflers should quickly reduce noise to a minimum.

The power plant of the helicopter can be expected to use many products of the plastics industry. Laminated phenolics are well suited for cylinder baffles, fuel pumps, magneto insulating parts; polystyrenes for battery cases and separators. Certain gears and cams can be made of molded or laminated phenolics, and the entire engine may be mounted on rubber blocks.

The main rotor blades can be of all metal, plastics, stressed skin, or wood and metal composite. At the present time the two latter materials predominate. The rotor blades should be very stiff in the plane of rotation and have the right degree of flexibility along the span. In addition, the material from which they are fashioned should be fatigue resistant. It is very necessary because of the size of the blades that they be kept in almost perfect balance. With blades capable of absorbing moisture this is exceedingly difficult, and particularly with wooden blades, the moisture content of each will change, depending upon the density of the wood. This condition has made it necessary to store helicopters either entirely out of or in the weather to give the blades an exactness of exposure. Much of this trouble can be eliminated by use of compreg wood, metal or glass-fiber laminates, giving far greater resistance to moisture and impact.

The third factor necessary for mass sales is low operational cost. Helicopters must be produced to sell in competition with automobiles—and it is safe to say that they will be.

Opinions differ among potential manufacturers of postwar helicopters as to prices of their product. The Aeronautical Products, Inc., predicts that its postwar helicopter will deliver for approximately $2500; the Higgins Company feels that it can deliver a two-place job for about $1500. I feel that this latter figure is somewhat optimistic. The first postwar helicopters will undoubtedly be more expensive than later models, and a delivery price of $1500 would only be attained when helicopter manufacturers have raised the point of mass production comparable with that of the automotive field.

Planes of all types have not reacted satisfactorily to mass production methods. It costs (*Please turn to page 192*)

An analysis of material supplies*

by GEORGE H. SOLLENBERGER†

AT the beginning of the war, shortages in plastics supplies were usually the result of production limitations within the plastics industry and, as the bottlenecks were found, they were broken. However, during the third quarter of 1944 it became increasingly apparent that raw material availability rather than that of the plastics themselves was due to become the controlling factor. Since the chemicals industry is almost universally dependent upon a relatively small number of basic raw materials, it is easy to see how this could be true, how the impact of accelerated military programs could seriously affect the position of competing raw material claimants. The following breakdown of the individual materials handled by the Plastics Branch of the War Production Board should serve to spotlight the complications that can develop from this situation.

All the figures on raw materials that are given in this article represent estimates of current production and consumption rates based on reasonably accurate 1944 figures. Unless the contrary is specified, the figures cover total poundage during a 12-month period. Although not exact, they *are* indicative of the relative status of each material and any deviation would amount to but a few percent.

Much of the information in the WPB files is of a military nature and, obviously, cannot be released. Other material, classed as restricted, is presented in aggregate so that breakdown is impossible since such disclosure could result in unfair competitive advantage. Another and possibly the most important explanation for this lumping of statistics is that the Plastics Branch has been operating under an unusually heavy work load, and time for statistical research does not exist.

Phenolic resins and molding compounds

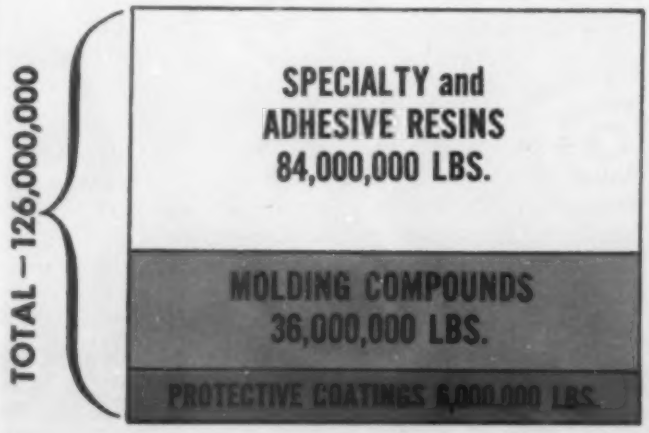
Because of the widely diversified fields in which phenolics play a part, figures on these materials must be broken down to some extent if they are to have any significance. Plywood resins are being turned out at the rate of approximately 36 million pounds a year. This represents a plywood output of approximately 600 million sq. ft. on the basis of 3-ply material which goes into boats, hutments, decking, gliders, power aircraft and similar equipment. Specialty resins, used in a large number of classified military applications, in grinding wheels, brake blocks, electrical insulation, heat-insulant bonding, stamping and forming dies for light metals, adhesives for metal bonding, ion-exchange resins for water purification and lamp-base cements account for another 55 million pounds.

Roughly, 96 million pounds of laminating varnish—60 percent resin is a good average for this material—is consumed in the manufacture of about an equal weight of laminates for electrical and structural uses, for helmet liners, instruction panels, silent gears and various corrosion-resistant items. Protective coatings for military and industrial equipment take another 44 million pounds or so of phenolic resin, while the manufacture of 120 million pounds of phenolic molding pow-

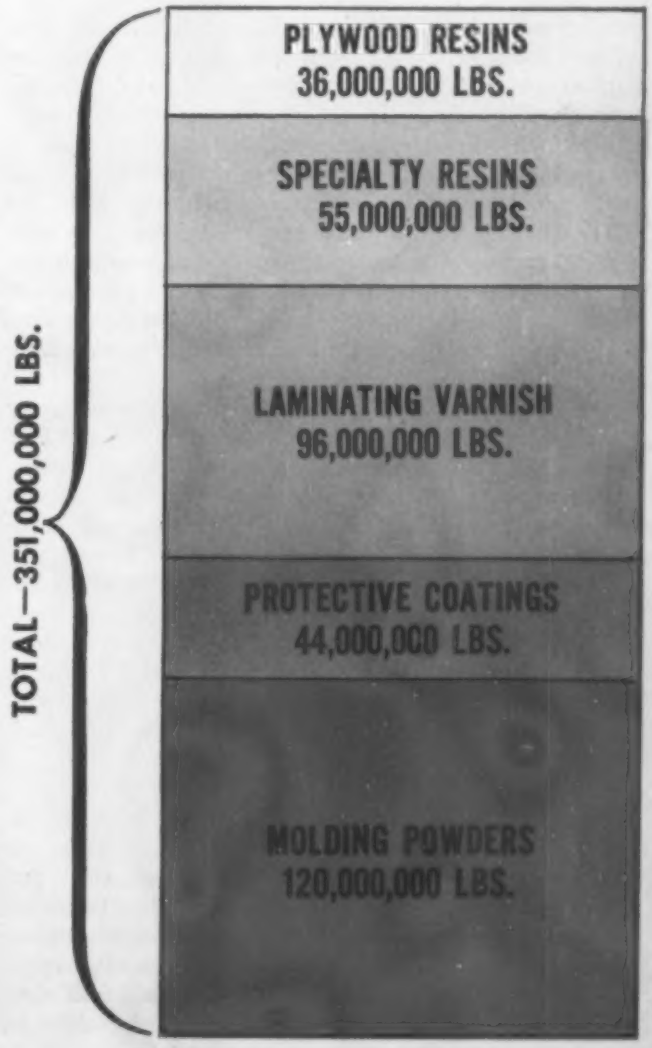
* Presented before a meeting of the chemical industry in New York City on March 2.

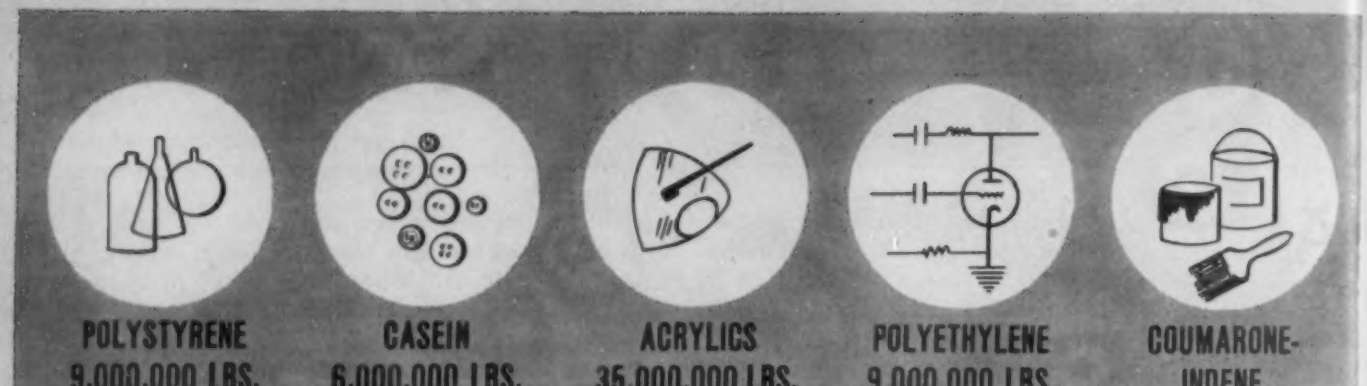
† Deputy Chief, Plastics Branch, Chemicals Bureau, War Production Board.

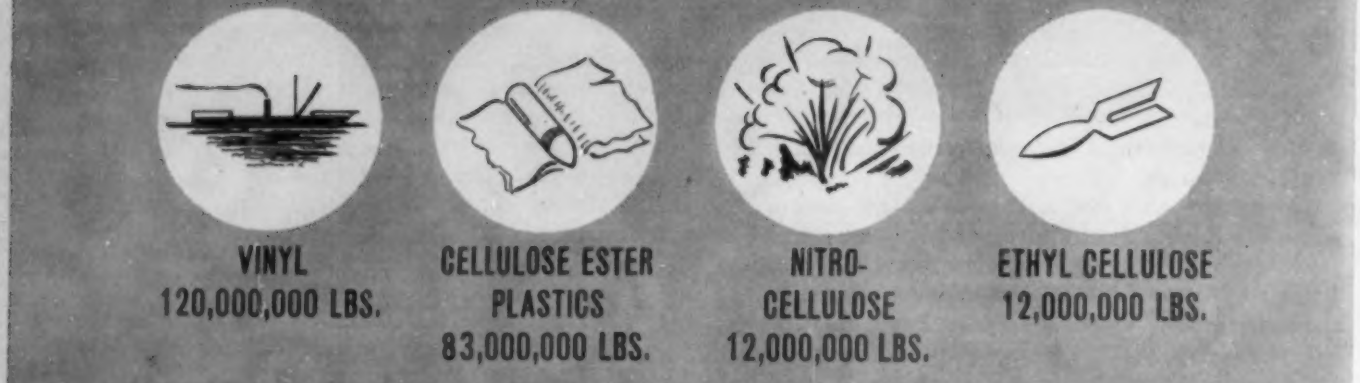
UREA and MELAMINE RESINS



PHENOLIC RESIN & MOLDING COMPOUNDS







ders for use in electrical items, Ordnance and other classified military parts, in communications equipment, closures and buttons consumes 48 million pounds of the resin. Incidentally, closures and buttons are, presently, on short rations.

The total figures on phenolic resin and molding compound approximate 350 million pounds. For this output, an intake of 135 million pounds of phenol, cresol and cresylic acid, and of 146 million pounds of formaldehyde is required. In addition, other raw materials such as asbestos, woodflour and macerated fabrics enter the picture, not to mention considerable tonnages of dyes and pigments. Incidentally, the same holds true of the dyes and pigments used in nearly all the materials mentioned in this article.

Since early in the 4th quarter of 1944, the limited availability of phenol—derived from coking operations and from benzol—has, to some extent, held down the production of phenolic resins. The months of January and February of this year were exceptions, for during that period formaldehyde was the critical material due to transportation difficulties that delayed deliveries of both methanol and formaldehyde. The cresols and cresylic acid have also caused trouble from time to time, due to spotty availability, and at present the situation is rather serious. No relief is in sight for any of these raw materials, and it is entirely possible that the situation may deteriorate still further before any improvement takes place.

Urea and melamine resins

The urea and melamine resins are comparable to the phenolics in that the total output of these two materials—126 million pounds of resin and molding compound, which consume 102 million pounds of formaldehyde—must be broken down into its several components before the figures assume much meaning. The tonnages of urea and melamine crystal cannot be presented, as there is only one producer of each.

The specialty and adhesive resins are running about 84 million pounds. They are used in high wet-strength paper for maps, blueprints and invasion currency; in laminates; in plywood for such miscellaneous end uses as shipping containers; in wood-working adhesives; paper laminates for V-boxes; foundry sand-core binders; and in textile treatment to reduce shrinkage, to increase wear and to make shoddy fabrics usable. Urea and melamine molding compounds account for 36 million pounds of the 126 million pound total. This, of course, includes the bulk fillers. The protective coating use of these resins eats up 6 million pounds.

In January and February of 1945, these resins also were in trouble due to formaldehyde difficulties. Earlier, serious trouble was encountered as a result of competition for production time among ammonia for mixed fertilizer, methanol for Lend-Lease and methanol for normal domestic industrial uses such as the production of formaldehyde. Such a situation can arise again at any time, but it is believed that the output of urea resins should be able to continue for an extended period at the present level.

Cellulose plastics

For the cellulose-base plastics three broad groups may be established. They are: cellulose esters, nitrocellulose and ethyl cellulose.

The first—cellulose esters—is the large production item, amounting to about 309 million pounds of flake, of which in the neighborhood of 228 million pounds go to acetate yarn and staple fiber. The balance, 81 million pounds, is the base material for lacquers and for 17 million pounds of sheeting and 66 million pounds of molding powder. Figures on the poundages of butyrate and propionate are incorporated in these totals, since they are produced by one firm only.

Cellulose ester plastics are currently in great demand for many highly essential uses, such as aircraft and glider glazing, Grade C Ordnance wrap, pres- (*Please turn to page 200*)

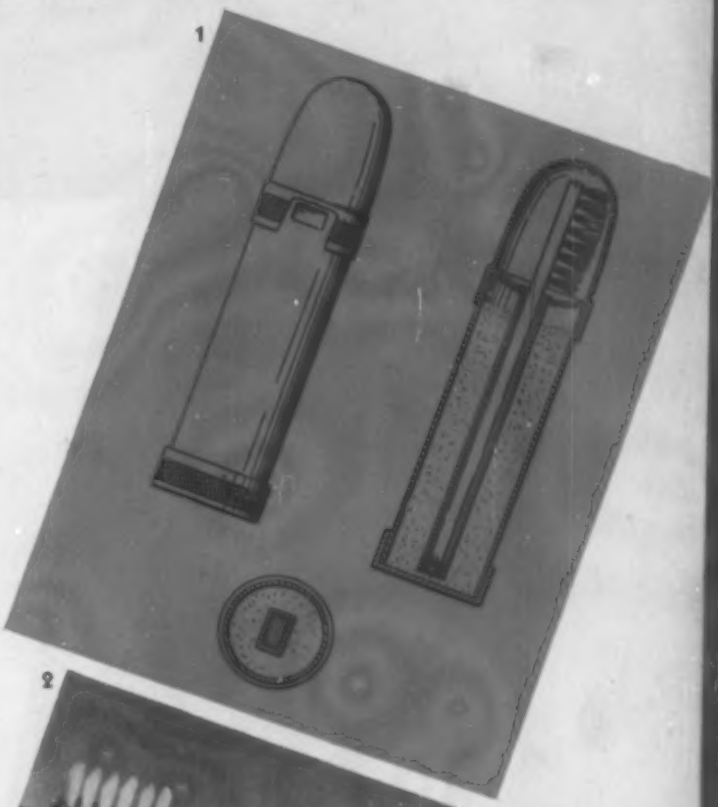
New opportunities in postwar markets

by B. M. STERNBERG*

MANY manufacturers are now searching for new products; and many of the new products offered for the postwar market bear close watching by plastic molders and others in the industry, because plastics are going to have increasing competition from zinc, aluminum, magnesium and many other materials.

The New Products Division of Designers for Industry, Inc., is constantly being offered an amazing variety of items in which plastics, in a wide sense of the term, may in some instances be profitably employed. The function fulfilled by this Division is but the first stage in the determination of the manufacturing and marketing potentialities of the product prior to any further developmental work. Thus the New Products Division is a clearing house for new ideas which, after thorough study, investigation and preparation in which all other divisions of the company participate, are offered to the concern's retaining clients who are in search of new products. Being quite familiar with their clients' facilities and

* Director, Merchandise Engineering Div. Designers for Industry, Inc.



1—This patent drawing of a toothbrush and powder holder exemplifies the first stage in which products are sometimes received for development purposes. 2—At other times models are presented to potential manufacturers in a more finished state. This model toothbrush is an example of such an instance. 3—The outstanding feature of this brush is the novel finger-fitting design of the handle. 4—The handle also prevents bristles from coming in contact with the holder as they do when a toothbrush handle is of conventional design

4 ALL PHOTOS, COURTESY DESIGNERS FOR INDUSTRY, INC.

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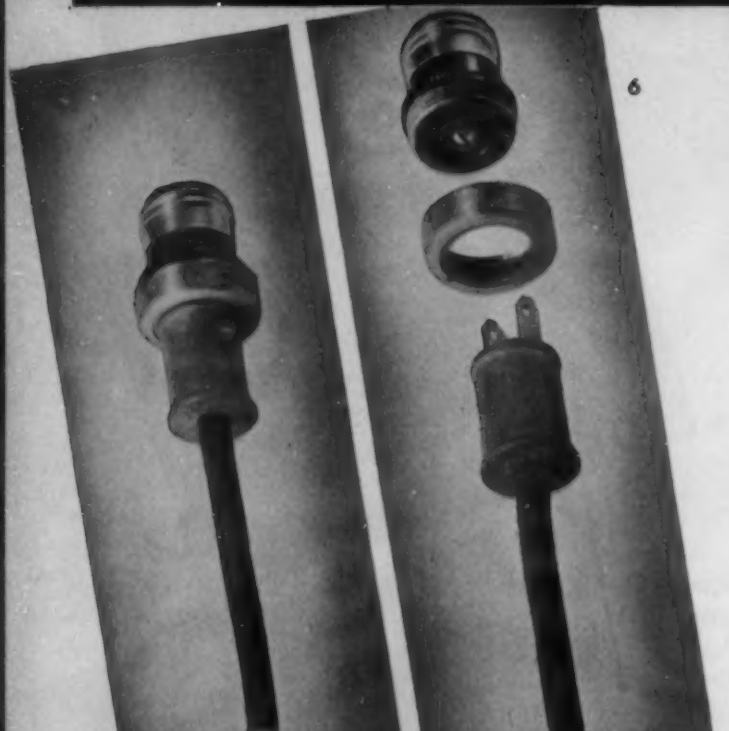

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***5**—This multiple fuze which relies in great part on its plastic components for strength and utility, has already passed the underwriters. The assembled unit is shown at the left; the parts are laid out to the right of the complete fuze. **6**—This original model of an improved plug must undergo considerable design and development work before the product can be presented for a manufacturer's approval. **7**—These miniature peepers are designed to be used either with or without glasses*

outlets, the company can offer a selection of new products that are readily adapted to manufacture under specific conditions. Other related services include model making, styling, market surveys, design of mechanical features, selection of materials, molding operations and controls.

But just how will plastics fit into some of the products now offered by various inventors through this concern? The best answer lies in an examination of several specific cases, each exemplifying one of the various steps involved in the presentation of a finished item. Each of the examples is in a different stage of development—from new items, just received, where only the patent papers are available, to articles which are already in production. In between are samples in various stages of handling. Some are available only in model form, some have been produced on an experimental scale, some are waiting action by a client pending determination of the method of manufacture. At present writing each of the examples, selected from among many in the files, represents a real and specific challenge and opportunity for the energetic and interested plastic molder searching for new products.

An inventor who has secured a patent has just come to the New Products Division with his patent sketch (Fig. 1). The product idea is a good one; it constitutes a toothbrush container for traveling. The toothbrush is concealed in a hollow stem inside the container. The container itself is unique in that it also holds a liberal supply of tooth powder. The powder is poured into the end of the container from a commercial package and the base cap is screwed on. A dispenser-style collar with a pouring opening is located just below the cap which protects the brush. After removing the brush, the collar below the cap is turned to uncover the opening which dispenses the powder in the usual manner.

This complete unit is a natural product for a plastics molder, as is the toothbrush. After styling in the proper proportions, the item will be offered to clients who can then make their own terms with the inventor. If the container is to be made from plastics, injection molding would be indicated, using cellulose acetate, a methacrylate or polystyrene. If it is to be produced by a metal working plant, the product would, of course, be designed to that end.

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8 and 9—This flashlight circuit tester is at a stage of development where production samples—such as is pictured here—are available. The product readily adapts itself to injection molding. 10—Before this metal model of a stamp roller could be considered as a possible plastics application, considerable basic redesign would be necessary. 11—A plastic thimble socket is a useful tool when work is located in hard-to-reach places. 12—Mockup of 4-pack cigarette box

Another similar item, still in the New Products Division, is an improved toothbrush, known as the Prop-o-grip toothbrush, developed by an established dental surgeon in New York. Figure 2 shows the model brush, while Fig. 3 gives emphasis to the finger-fitting features of the new handle. Figure 4, wherein the new style brush is compared with a conventional one, demonstrates yet another feature of the highly styled yet functional grip which not only acts as an aid to correct brushing of the teeth but also serves to prevent the bristles from coming in contact with the holder. Injection molding of cellulose acetate, cellulose acetate butyrate or methacrylate is a clearly worth-while method of manufacture. Nylon bristles could also be used to advantage. Here is a patented item which will interest those wishing to add a toothbrush of the better grade to their line.

Take another field entirely, and see how plastics will fit into the manufacture of new ideas for electric connections and fuzes. In the case of the visible multiple fuze (shown assembled and disassembled in Fig. 5), the New Products Division was offered a patented item with development and styling already in a fairly advanced stage. The multiple fuze offers the buyer three visible fuzes for the price of one and the fuze is unique in that it can be easily reset by a simple turn of the knobbed cover. An inspection window allows the user to examine the fuze element at all times. Without this window, a multiple fuze is of limited value since one cannot otherwise tell which element may be burned out. Use of a thermosetting material such as woodflour filled phenolic or melamine, either transfer or compression molded, is clearly indicated for the fuze body and turning cap. Other components of mica, brass and zinc are along the line of standard electrical items. The savings in shipping weight is another of this fuze's desirable features. It should not be wanting a manufacturer long.

Figure 6 shows yet another form in which ideas are received. Here is a partially worked out design in a handmade model of an improved plug. This new electric iron plug which will not pull or fall out, is a good application for plastics. The conventional screw plug is threaded on the upper edge. A collar is provided for the plug which, after the prongs of the unit are in place, can be screwed onto the threaded portion

of the item, firmly uniting the plug-in fixture and the plug. The collar does not interfere with the use of the plug in any ordinary wall outlet. All three major components can be readily made of ordinary electric fixture grade thermosets.

It is logical to expect that such an assembly will find many uses in the postwar home—on vacuum cleaners and irons, and other appliances where the conventional plug is easily or accidentally pulled out—for it assures a positive connection till unfastened. Considerable styling remains to be done on this item, and the proper thread for cap and plug must be determined, depending on the material from which the components will eventually be manufactured.

A variety of products remain to which plastics may be applied. Figure 7 shows plastic "peepers." These eye shades are a natural application for injection-molded cellulose acetate. They are worn by tennis players, office workers and others who desire protection against strong light rays. This type of tunnel vision peeper may be worn with or without glasses and it is regarded as giving a more healthful protection to the eyes than do a great many of the lowest priced tinted glass lenses.

A flashlight circuit tester is pictured in Figs. 8 and 9. This patented item now consists of metal stampings and a composition tube. However, it offers the plastic molder wide scope for redesign as an all-plastic light, to be injection-molded of butyrate, with an acrylic lens, and a vinyl- or polyethylene-coated cord and plug on the circuit-tester lines. This useful maintenance tool may be used as a regular flashlight, or for testing circuits.

By increasing the utility of a commercial light through the addition of the circuit testing feature, the sales value of the light has been materially broadened. There is no reason, then, not to enhance the appeal of the product still further by taking advantage of the experience of numerous molders in the injection molding of Army and Navy flashlights. Vinyl materials might well be used to make a shockproof factory maintenance tool, while colored acetate or butyrate might be employed for a circuit tester to be used in garages and filling stations, and to be sold through automotive supply stores.

While the New Products Division fully appreciates the sales value of redesigning for plastics, it cannot always suggest plastics. The client to whom the article is to be presented may not have molding facilities and may desire to make use of available equipment for metal stamping, turning or forming. There is no reason, however, why enterprising molders cannot suggest to the manufacturer a worth-while change to plastics.

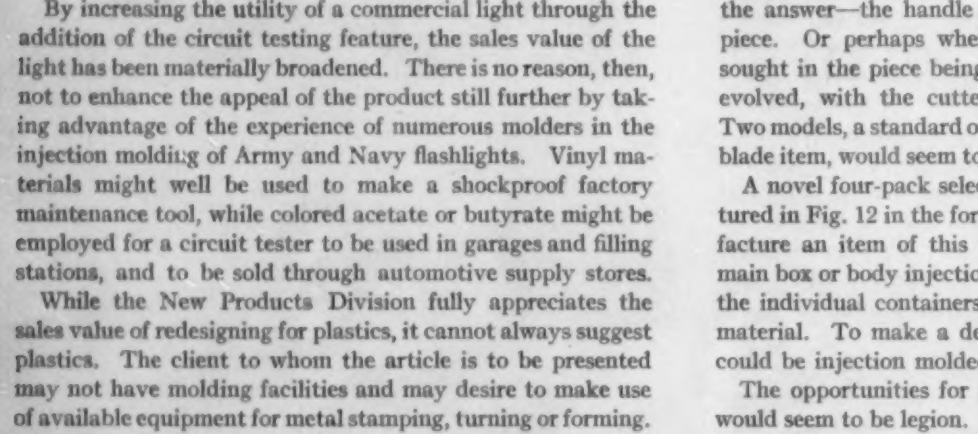
The thimble socket shown in Fig. 11 is designed to be made of plastics—at least the inventor had a shock-resistant material in mind when proposing the idea even if he was not acquainted with the specific plastics that would be most suitable. The screwdriver—or socket wrench, if the ratchet-type extension is in place—is put on the tip of the forefinger of one hand. The lower portion is then turned by the thumb and three remaining fingers. Injection-molded of cellulose acetate, this tool will find a ready market waiting for it among our mechanically minded public.

Unlike this last idea which, by its very nature, almost anticipates the use of plastics, there are others which call for considerable structural redesign if plastics are to fill the bill as adequately as metal. Examples of products falling into this category are shown in Figs. 10 and 13. The stamp roller —a self-inking device for marking letters, making margins, embellishing promotional literature, etc.—would be a good product for a plastics molder provided inserts were used for the roller shaft in the arms of the frame. No stress or condition of use is involved in this application which lies beyond the present available range of plastics. Yet considerable engineering would be required before a satisfactory substitute for the metal frame could be found in the molding field. The item remains as a challenge to a progressive molder.

Figure 13 illustrates a potato and vegetable cutter which the inventor originally submitted in an all-metal design, except that a molded handle of some type might have been indicated. The slicer has three removable blades. For diced beets, as an example, the dicing cutter is installed. The beet is pushed along the platform and passes through the cutter. Here again, the entire unit is capable of redesign for plastics except for the cutter blades and possibly the posts which support the cutter blades (where inserts are obviously called for). Probably compression-molded urea formaldehyde would be the answer—the handle and platform being molded in one piece. Or perhaps where interchangeable designs are not sought in the piece being cut, a single-blade cutter could be evolved, with the cutter blade actually molded in place. Two models, a standard one-blade item, and a deluxe multiple-blade item, would seem to be indicated.

A novel four-pack selective-type cigarette dispenser is pictured in Fig. 12 in the form of a wooden mock-up. To manufacture an item of this type it is possible to visualize the main box or body injection molded of a colored acetate, while the individual containers could be molded of a contrasting material. To make a deluxe item, the various components could be injection molded of polystyrene or an acrylic.

The opportunities for plastics to reach into new markets would seem to be legion. We have presented but a few of the more typical cases which present a challenge to the molder to undertake their manufacture. Not in every instance has the inventor contemplated plastics. Not in every item is the case for plastics clear cut. But it is plain to see that the time is fast approaching when mere availability and the fact that "plastics is a magic name will be subservient to the functional needs of a product. Then the molder will have to exert himself to capture products such as those illustrated.



13—This potato slicer requires a very rigid construction if it is to operate efficiently. It would seem that the use of several inserts would be advisable if the unit were to be reproduced in plastics

A new frontier

DOCTOR LEO HENDRIK BAEKELAND

As a tribute to the accomplishments of Dr. Leo Hendrik Baekeland, a joint meeting was held by the American Section of the Society of Chemical Industry and the New York Section of the American Chemical Society on Feb. 9 in New York City. The article that follows was condensed from a speech delivered on this occasion by George Scribner, president of the Society of the Plastics Industry.

ANY evaluation of the contributions of Doctor Baekeland to our modern living should be divided into two sections. First the discussion of the conditions existing at the time he announced his discovery, and secondly, the characteristics of the materials he pioneered.

The plastics industry likes to reach back for its beginning to John Wesley Hyatt and his discovery in the year 1868 of the possibilities of the combination of nitrocellulose with camphor. The reason for selecting this date probably is because at this point the most overworked word in our plastics vocabulary first became dominant—the word "synthetic." In all our struggles through the years to agree on a satisfactory definition of our materials, this is almost the only word that is always accepted without question. We could just as well have gone back to Charles Goodyear and the date of 1846, except for the existence of the overwhelmingly large rubber industry and the fact that acceptance of that date and that point of origin would have made us a stepchild.

From the time that Hyatt started the pyroxylin business, on through the end of the last century and up to Doctor Baekeland's taming of the reaction between phenol and the aldehydes, very little real progress was made in the plastics industry. Shellac became popular as a binder; cold molded materials, based on both bitumens and heat-resisting cements, built their own market.

It would seem that in the late 'Nineties our practical science was more or less marking time, getting the laboratory work out of the way so that manufacturing and designing for use could get a bird's-eye view of the possibilities and decide how to use the new developments for profit.

It would be presumptuous to try to tell what Doctor Baekeland had in mind with respect to form of product and future market when he decided to tackle the problem of the reaction between phenol and the aldehydes. Based on the results many others had achieved over the previous fifty years and the demands of the only market he could see at the time, it would seem that he was aiming at a replacement of shellac and the various fossil gums then used for the body of coatings, varnishes and paints. His predecessors had wound up with shapeless masses that would be very efficient if they could be worked down to a protective film. When the Doctor finally succeeded in drawing off from his still or kettle an amber-colored fluid, everything would have seemed to point the way toward the fact that the coating field was the obvious market.

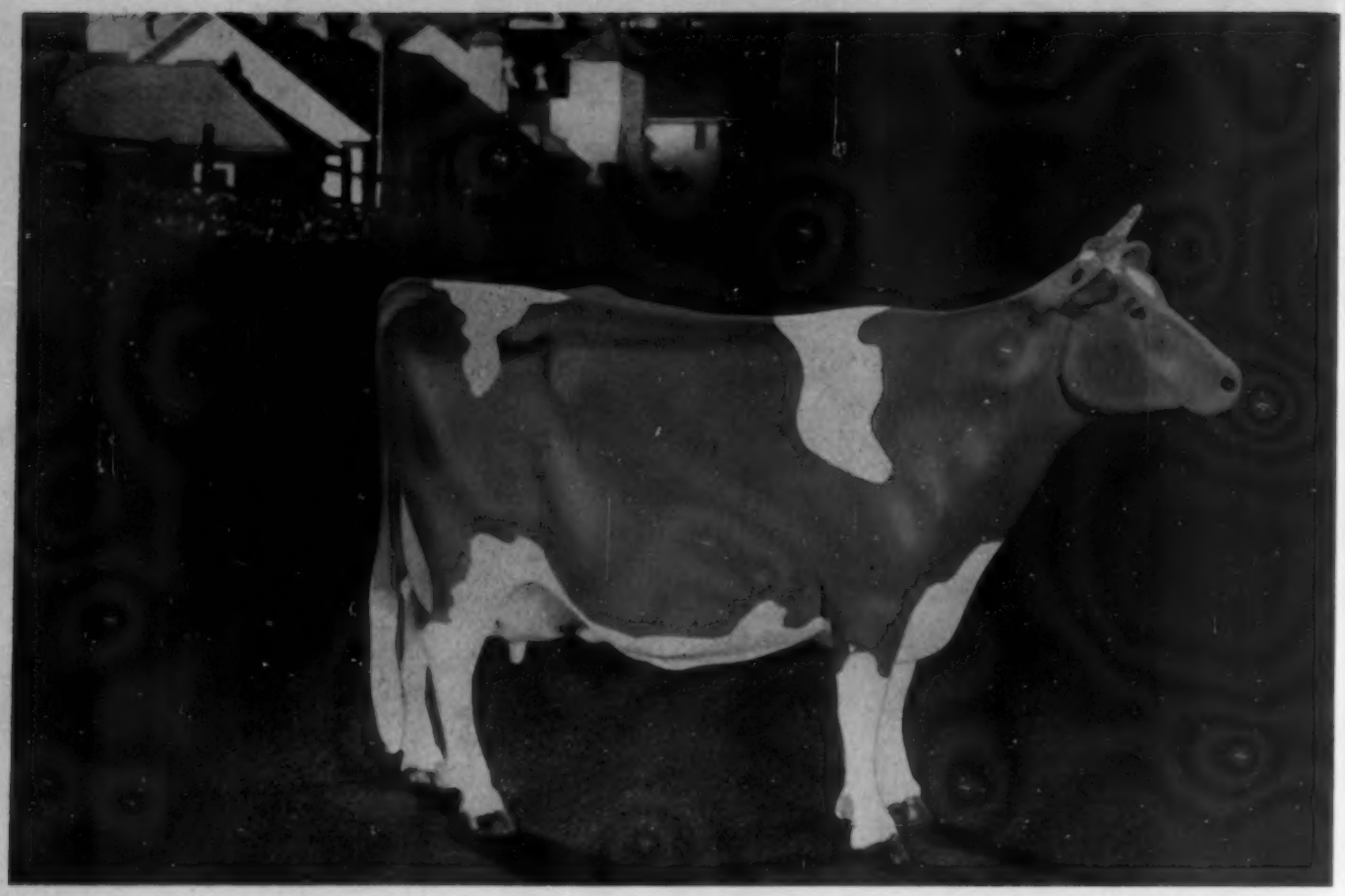
After Doctor Baekeland finished his development of Velox paper and sold it to Eastman Kodak Co., he did some work for Boonton Rubber Co. on the recovery of naphtha used by them in reclaiming rubber from scrap. This resulted in a new material that was soft under the initial application of heat, then hardened to a practically infusible form. Richard Seabury of Boonton Co. had been using a rubber solution, mixed with the proper amount of sulfur and with asbestos fiber, as a molding compound. However, after hearing of this new resinoid, he substituted it for the rubber sulfur binder they had been using. The substitution worked out just as he had anticipated, giving an accurate duplication of the mold and holding its shape under mechanical, electrical and chemical stress better than the old binder.

The scene shifts to Elizabeth, N. J., where Doctor Edward Weston was building a line of instruments to measure and control electrical impulses, a field that seemed quite promising at the time. Doctor Weston had a great deal of trouble finding small parts accurate enough to function in the limited space of his instruments, and shapeable at a cost that was low enough so that they would not dominate the ultimate selling price. Those that he could find had an additional drawback—they would not keep accuracy after assembly.

Since Doctor Baekeland had done no work along the molding line, Mr. Seabury and Doctor Weston proceeded to explore the possibilities of making these small, accurate parts in steel dies. Asbestos fiber soon proved too coarse and therefore too inaccurate. After many experiments wood flour was used as the filler and the molding business began to assume its final shape.

At the same time that Mr. Seabury was experimenting with the molding end, Doctor Baekeland was impregnating sheets of paper with his resinoid, pressing them into panels of various thicknesses and developing the base for the present laminating trade which became a substantial business before the molding reached a fully developed state. The impregnation of motor coils was another natural move which, although it was attended with many false starts, rapidly attracted the attention of the electrical trade. When the Doctor first looked around him and tried to evaluate the possibilities of his material in the light of current demand, he estimated that there were about forty-three industries in the world which could use his product. Today it would be very difficult to find forty-three that do not use that product.

It turned out that there were scores of industries that were waiting for the new material. A plastic that could be molded to form, that would stay put (*Please turn to page 198*)



1—Wherever breeders and buyers of cattle meet to determine the relative merits of respective Guernseys, they will now have a basis for judgment in this model Guernsey molded of cellulose acetate butyrate

A basis for judgment

WHAT is perfect? This question is a constant worry to all animal breeders, for the "ideal" of any strain has never existed except in the minds of producers and judges. And, since there are as many different mental pictures as there are minds, the basis for judgment is ever varying. For example, a Guernsey cow is graded on five classifications, each of a different value. Out of 100 possible points listed on a judge's grading sheet, 24 are assigned to general appearance, 20 to dairy characteristics, 20 to body capacity, 30 to mammary structure and 6 to feet and legs. But one judge may give 20 points to one Guernsey for general appearance at the same time that another judge is completely reversing the grading on his score sheet. The explanation? Simply the fact that the "ideal appearance" conjures up a different picture in the minds of different judges. As a result the tabulation serves only as a guide to prevent too high a value being put on any one of the five classifications while another is passed over too lightly.

To put the judging of Guernsey cattle by both breeders and buyers on a more concrete basis, the American Guernsey Cattle Club and Montgomery Ward & Co., in collaboration, have produced in cellulose acetate butyrate a model Guernsey. By helping to resolve doubts as to just what constitutes the "ideal" type, this miniature cow should prove invaluable to veterinarians, to instructors and students in animal husbandry, to youngsters engaged in 4-H work and to others active in the breeding, buying and judging of cattle. Reference to this model should simplify the settling of differences of opinion as to what is "ideal" in a Guernsey. The ultimate result—an improvement in the breed.

The original model for this plastic cow was carved from wood by Carl Holsthammer, a noted sculptor, under the guidance of members of the Type Committee of the American Guernsey Cattle Club. Cows in the "close to ideal" class were used as models. For example, the Curtis Candy Company's famous "Babbie" for which it paid $12,750, supplied the body outline and stance; another cow was the model for the udder; while yet another Guernsey modeled the hind quarters. In all, six cows contributed to the near perfection of the wooden figure. The result—a miniature, one-ninth life size and one of the best-proportioned "little Guernseys" the human eye has ever seen—was presented to the American Guernsey Cattle Club at its annual meeting in May 1944 and enthusiastically accepted by the officers of the Club and the hundreds of members who were in attendance.

The cellulose acetate butyrate Guernsey model measures approximately 7 in. from the bottom of its hooves to the tip of its horns, about $9\frac{1}{2}$ in. from nose to root of tail and $3\frac{1}{2}$ in. across the width of its body. The 8 different molded parts from which it is assembled are shown in Fig. 2. These consist

of the two halves of the body, the belly and udder section, the tail, the two ears and the two horns.

It was important, since this plastic miniature was to serve as a model of the breed against which the good and bad points of a live animal could be weighted, that the detail of the original wooden figure be duplicated in the mold, cast of low melting point bronze. To achieve this delicate modeling the entire surface of the molds, as cast from the original model, was chased by hand—the most highly skilled engravers being employed for this work.

Two combination molds were designed for the production of the 8 plastic parts of this miniature Guernsey. One mold has 3 cavities—one for half of the body including two of the legs, one for the tail and the third for the belly and udder. The second mold is a combination five-cavity die with one cavity for the production of the other half of the body with the legs, two more cavities for the ears and another two for the horns. The edges of all eight pieces are designed so that the parts dovetail—insuring a perfect match. As molded, the rear end of the cow contains an undercut. This was molded by moving the joint line to the center of one leg and using a side pull in one cavity, causing the mating side to become a straight pull.

Jigs are used in the assembly of all the different pieces that go into this miniature Guernsey. At first, acetone was used to join the sections, but it was found to dry much too quickly. Now a special butyrate cement is employed.

The painting of this model Guernsey, a finishing operation that is the responsibility of Montgomery Ward & Co., has proved to be unexpectedly troublesome. The American Guernsey Cattle Club specified, as the technically correct color, a combination of golden-cream and red for the dark spots on the cow. The paint for the hooves and the base of the horns was to contain more orange while a dark color was stipulated for the tips of the horns. According to the Club, the inside of the ears should be (*Please turn to page 194*)

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2—*The model cow is molded in eight parts, consisting of the two halves of the body, the belly and the udder section, the tail, the two ears and the horns.* **3**—*Careful attention to detail in molding is evident in these rear and front views of the assembled Guernsey model*

1

Hearts and flowers

SOME artists and designers select plastics as their medium because of the facility with which massive blocks of the material can be shaped to express the most subtle emotion, because of the wide range of colors in which it can be obtained, and because of the many and diverse forms in which it is available. It was the challenge offered by flat sheets of transparent cellulose acetate, however, that first aroused the interest of Emile Norman and turned him from painting and sculpturing to decorative work in plastics.

Transparency bespeaks lightness and delicacy—qualities which Mr. Norman felt were too often belied by carefully polished, plain-surfaced applications of this clear plastic. The smooth planes of this material seemed to call out for some manner of surface treatment. There was need for fluidity of line. Light passing unhindered through the medium lacked sparkle and life. It needed to be broken into a thousand planes, picked up, diffused.

In much the manner of the European craftsman—working always alone, seldom duplicating his designs, and fashioning each piece by hand—Mr. Norman sought the means of transferring these ideas to the sheets of plastic. New tools, special dyeing techniques, unique cutting methods, gradually emerged during the two years he spent perfecting his craft.

The first decorative objects that emerged from this period of trial and error have more than beauty of line and surface texture. The proportions and the construction of each piece seem to have been worked out with precision, the end use always in mind. Table decorations are reinforced at the edges where they might be knocked or jarred when filled with flowers. Jewel boxes are fashioned to withstand daily handling and the repeated opening and closing of the lid.

The variety of effects and uses to which the technique of surface decorations and linear fluidity can be applied is well exemplified in the ornamental and utilitarian objects shown in Figs. 1 and 2. Table lamps, picture frames, shadow wall boxes, ballerina headdresses, corsages, table centerpieces, valentines—all are typical of this work. Frequently, baroque scrolls are combined with the surface ornamentations. Motifs appear superimposed on the background by reason of a pointillist-like pattern of dots, which give the impression of erosion. Translucent patterns emerge from a background of light and shadow. Occasionally, sprinklings of tiny flowers cover the surface, producing iridescent effects reminiscent of childhood dreams.

The wax-flowers-under-glass cherished by Victorian decorators and the spun-sugar fantasies created by imaginative confectioners are instantly brought to mind by the large table lamp pictured in Fig. 1. The flower motif is emphasized throughout—the pedestal simulating enveloping leaves, the window in the base tracing the outlines of a bud. And by reason of this emphasis, the plastic flowers that fill the interior stand out with striking intensity. In this piece the pattern of raised dots that cover the surface is made more prominent by a dark background applied to the underside of the transparent sheet. A variation of this same surface treatment outlines all exposed edges, much in the manner of decorative frosting.

The ballerina headdress that rests on the table beside the lamp is both practical and beautiful. The theater demands a brilliance in its costuming that would be shocking in street clothes. In the past, weighty quantities of colored stones and heavy folds of rich materials were needed to give the richness

that would carry across the footlights. Now, with the plastics taking the place of these other materials, a new lightness is achieved. And this lightness is not simply a physical matter although that, in itself, would be sufficient reason for a change. There is, in addition, a visual airiness in these headdresses that is new to the costuming art. In this particular crown, designed to be worn by the ballerina, a roughened surface is again employed to catch and diffuse the light. The tiny star shapes scattered at random across the curved fingers of the plastic sheet, glitter much as they would if powered by miniature lamps.

Both the headdress and the corsage of pink and white flowers that hangs beside it in Fig. 1 are almost startling in their delicacy. Partly, this can be attributed to the technique used to manipulate the sheet material until it conforms to the desired contours. Partly, the effect is due to the fact that the objective is simulation—not imitation—of nature.

The petals and leaves are not edged with wire reinforcement as is the case with many artificial flowers. In some instances, a single support runs through the center of a leaf. Again a tiny bud perches on the end of a fine wire stem. But, on the whole, the plastic is designed to provide its own support.

Color is another explanation for the beauty of these floral arrangements. The effects that are achieved have a softness that approaches the coloring found in nature—one shade blending imperceptibly into another.

But color, and even surface decorations, are sometimes cast aside as in the case of the picture frame shown in Fig. 1. Here the single spot of red in the oil painting is given emphasis by the brilliant border. It remains for the plastic cover piece to draw the eye from the red and black backing to the heart of the painting. To achieve this effect the cellulose acetate sheet is cut so that its outside edges follow the black pattern in the border. The plastic also serves to mute a part of the red edging of the picture and to give depth to the entire work.

When grandma is the subject of a painting, the picture frame is cut from material colored a deep pink and then spattered with varied bits of jet. A small landscape of trees in a fog is set in a deep concave frame consisting of two flounce-like layers of plastic. The lower tier of this frame is fashioned from a sheet of plastic that has been rendered opaque by a back coating of black dye. And on its surface are painted tiny three-dimensioned calla lilies.

Another type of wall decoration is the deep shadow box. Each of these pieces contains a bouquet of plastic flowers and is covered with a sheet of clear translucent plastic upon which a border pattern has been etched.

The ghostly stagecoach (Fig. 2) is a table centerpiece that invites conversation. Old photographs dug from the files of museums and libraries were used as a guide to insure the accuracy of its design. And accuracy there is—even to a tiny velvet cushion fitted to the coachman's seat.

Again clear plastic sheet is the medium. However, except for four untouched areas that were left on the body of the coach to simulate windows, the entire back surface of the plastic is dyed black. The coat of arms and filigree borders are formed from the frosty dots that appear throughout this collection, giving sparkle and life to the material. The wheels, cut from clear plastic and unadorned except for a white edging, are phantom-like in appearance. Flower holders can be scorned when such a table decoration is on hand, for the coach is designed to hold bouquets.

The Victorian spirit of frosty decorationsand graceful curves, of delicately tinted flowers and birds finds full expression in the two valentines that are pictured at the extreme right and the extreme left of Fig. 2. In fact, the transparent violin case, tinted a soft pink, looks like the materialization of Valentine's Day itself. And as an extra surprise, a dusky pink plastic rose lies at the heart of the violin.

The second valentine is reminiscent of the cut-out paper greeting cards that once were so popular. Like the violin case, its surface is frosted. Both these pieces demanded the most painstaking effort for they seem to be composed of one curving strip of plastic after another.

Already Mr. Norman is at work developing and perfecting surface treatments and new methods of handling. With each day he is adding new plastics to his list of materials.

Credits—Material: Lumarith. Designs by Emile Norman.

2

1—Lightness and brilliance are the qualities that surface decorations seem to give to transparent sheets of plastic. 2—Table decorations and such sentimental pieces as valentines are ideal subjects for decoration

Varying silicone formulations

NEW inventions that completely change our way of living are few and far between. Their dates are marked down in the books of history, to be remembered as starting points for new epochs. Yet it is the refinements of these revolutionary discoveries—the developments, unheralded except in the professional fields, which improve their component parts—that are responsible in good part for our present standards of production and for the records we have been able to run up in first-class fighting equipment. For example, the engines that power today's fighting planes are, in basic principle, no different from the motors in use at the outbreak of the war. The increased power and longer life, the savings in weight and the greater ease of maintenance that characterize these latest airplane engines are due to improvements in the arrangement of their component parts and the materials that go into them.

One of the most important of these improvements and one whose ramifications will be felt in equipment of all types has come as the result of the development of more heat-resistant materials. Perhaps the newest of these materials to be made public is silicone rubber[1] a product whose outstanding characteristics, in its present stage of development, are a high temperature stability and a low compression set at high temperatures.

The importance of these two properties is evidenced by the essential uses to which the entire output of the present pilot plant is being applied and by the fact that plans are now in progress to increase the manufacturing facilities for the material. For example, silicone rubber forms the gasket for the turbosuperchargers in the B-29 bombers. In these planes, a turbine drives a supercharger which compresses the thin air at great altitudes and feeds it to the engines at sea-level density. The turbine, in turn, is driven by gases from the exhaust which have a temperature in excess of a thousand degrees. Thus, the turbine is subjected to high temperatures even though the air outside the plane may be very cold, as during substratosphere flights. The compressor casing of the turbosupercharger is more or less shaped like a doughnut from which a bite has been taken. A leak-proof cover plate is therefore needed to close off one side of the break in the hollow casing.

The sealing of this cover plate is now accomplished by means of a silicone rubber gasket which has been found to remain soft—in fact, little or no change in flexibility occurs—even after 150 hours of continuous operation of the turbosupercharger at a temperature of 300° F. Under similar operating conditions, natural rubber failed to retain the required resiliency over a protracted period of time and one synthetic rubber gasket that was tried out became hard and brittle after 100 hours of operation.

Equally interesting is the use of silicone rubber gaskets on Navy searchlights. If these lights, which help control the fire of guns at night, are to operate with maximum efficiency, they must be placed as close as possible to the battery. And when this is done they are subjected to a terrific jarring each time the guns are fired.

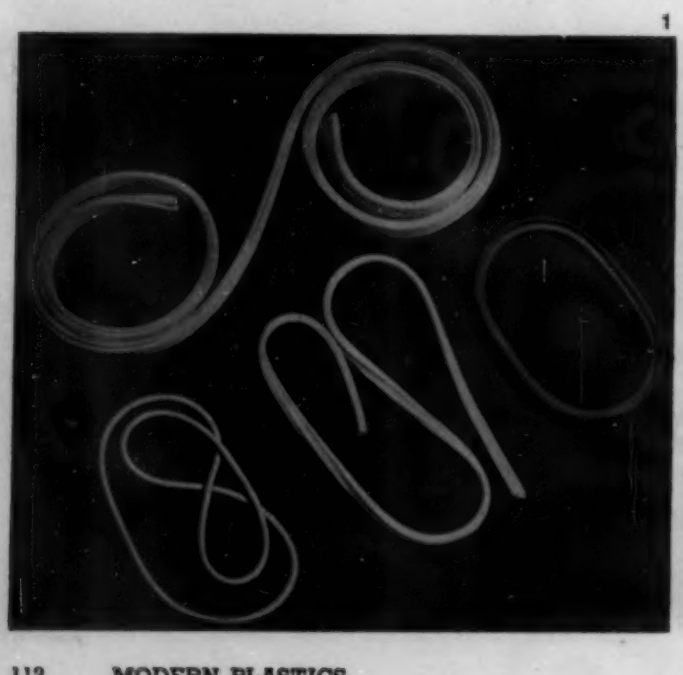
So that the glass front of these searchlights will not be shattered as the battery goes into operation, a gasket is fitted around the edge of the lens. At one time, asbestos was used in this application because of the excessive heat—running up to 338° F.—that is thrown off by the light. While this material withstood the high temperature it was lacking in resiliency and had a tendency to harden if it became soaked with water. Attempts to use rubber gaskets proved less than successful for although the rubber possessed the desired resiliency, it deteriorated when subjected to the high-heat characteristic of this application. Experience with gaskets made of silicone rubber, on the other hand, has shown them to combine the desired resiliency with the necessary heat resistance.

Tests on present silicone rubber formulations indicate that

[1] Development of General Electric Co.

1—These silicone rubber gaskets, of varying sizes and shapes, are typical of the use to which this material is being put during the war period. 2—Tubing for cable is another application for this material

1



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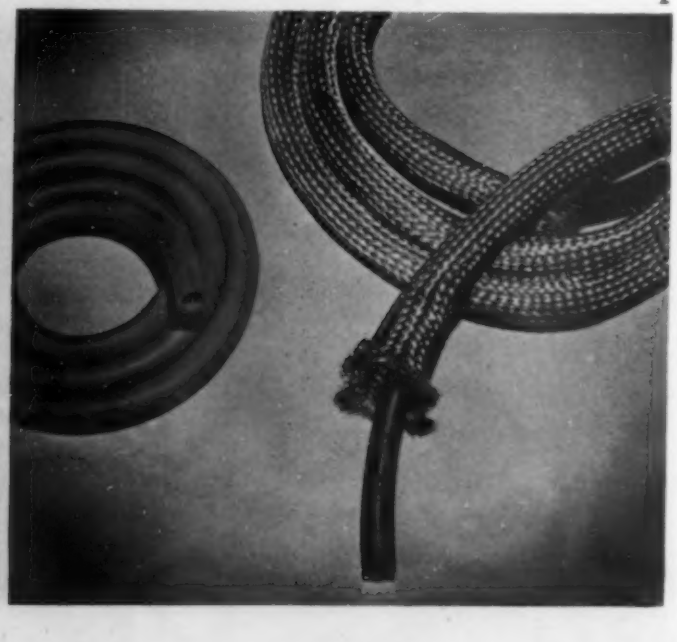


this material is capable of withstanding a temperature of 150° C. for a period of over a year and a temperature of 200° C. for several months. On the other hand, the latest silicone rubber sample does not lose appreciable flexibility before the temperature reaches −65° F. and does not reach brittle point before −80° F. No other rubbers remain flexible at these extreme low temperatures. The word "withstanding" in relation to heat indicates that the material does not harden and lose its resiliency. Exactly what the test figures on heat resistance will mean when translated into actual experience is a difficult question. However, since no one wants a product that would last forever, the importance of high-heat-resistant material will probably lie in the ability of equipment in which it is used to endure extremely high temperatures for short intervals over long periods of time.

When compared with synthetic and natural rubbers, test figures on compression set of silicone rubber show up favorably. Whereas a Buna S formulation has 100 percent compression set when heated at 300° F. for 6 hours, silicone rubber has but a 10 percent set when subjected to exactly the same conditions. In addition, this new material is affected by ozone, corona and ultraviolet light which act as deteriorants on natural and synthetic rubber. At present, however, silicone rubber is inferior in tensile strength and tear resistance, having a tensile strength of 750 p.s.i. compared to 2500 p.s.i. for Buna S.

While silicone rubber possesses many of the physical properties of rubber, it is entirely different in its chemical nature. In natural and synthetic rubber, the backbone of the molecule consists of long carbon chains in which the carbon atoms are joined by primary valence forces. The backbone of the silicone rubber molecule, however, consists of alternate silicon and oxygen atoms with two methyl groups (CH_3) attached to each of the silicon atoms. Consequently, while silicone rubber can be handled mechanically with standard rubber processing equipment, the chemical treatment is entirely different. The material may, however, be compounded with various fillers—many of the same type as are used in rubber processing. And it can be extruded on standard continuous extrusion equipment, and molded and vulcanized in a standard steam-heated press.

As stated previously silicone rubber is but the latest product of development work in the field of organo-silicon research.[2,3]

Organic compounds of silicon, that is, chemical compounds which have organic groups linked directly to silicon atoms with carbon-silicon bonds, first were made and studied by Friedel, Crafts and Ladenburg in the period 1871 to 1874. They found that other organo-metallic compounds (such as those of zinc and mercury) would react with the volatile silicon halides and esters to transfer the organic group to silicon. Then, in 1885, Polis found that the action of sodium metal on a mixture of silicon chloride and certain organic chlorides would attach organic groups to the silicon more simply and easily.

A much greater improvement came in 1904, however, when Kipping discovered that the organic compounds of magnesium known to chemists as the Grignard reagents could be used to transfer organic groups to silicon. This convenient, easily controlled reaction has become the standard laboratory procedure for making organo-silicon compounds, and for forty years Professor Kipping and his students at the University of Nottingham in England have (*Please turn to page 196*)

[2] U. S. Patents No. 2,258,218-2,258,222; 2,286,763; 2,352,974 (E. G. Rochon to General Electric Co.). U. S. Patents No. 2,306,222 (W. I. Patrode to General Electric Co.).

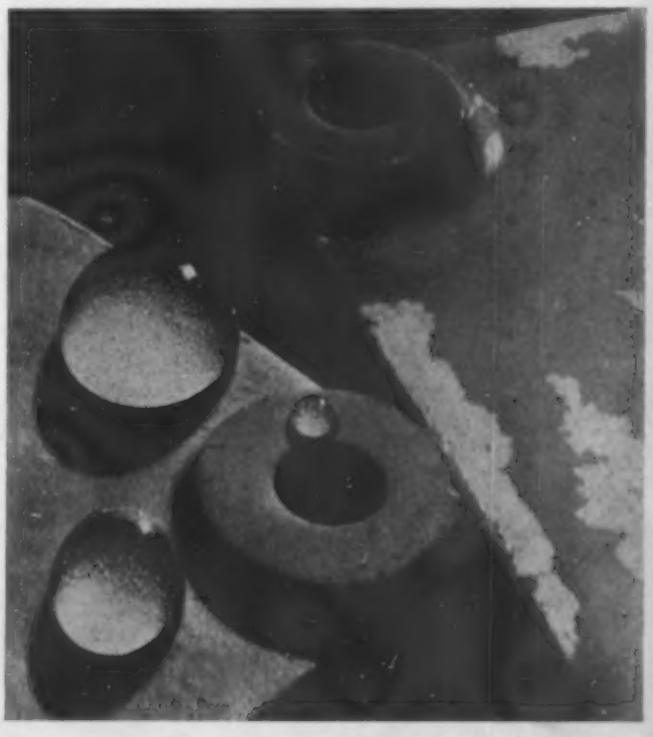
[3] "Silicones—high polymeric substances," Shailer L. Bass, E. C. Britton and R. R. McGregor, MODERN PLASTICS *22*, 124 (Nov. 1944).

3

PHOTOS 3 AND 4, COURTESY GENERAL ELECTRIC CO.

3—Here a gasket of silicone rubber, which remains elastic even at the high temperatures encountered near a high-intensity electric arc light, is applied to the lens of a 24-in. Navy searchlight. 4—The water-repellent characteristic of silicones is evident in this picture which contrasts a ceramic end plate that has been treated with a silicone formulation (left) and an untreated plate (right). The water stands in drops on the treated surface but spreads out on the untreated

4



ONCE THE BOMBING RUN HAS BEGUN, there is no turning back, no delaying while the bombsight is brought to working order. Yet the cold encountered at the high altitudes usually ordered for precision bombing is such that the delicate working parts of a Norden bombsight would quickly freeze up if the instrument were left uncovered.

It is for this reason that bombsights now are protected with electrically heated covers designed with a zipper down one side. The bottom of the cover is left open so that it can be closed through the use of a draw rope. Originally designed for operation on a 12- and 24-volt circuit, the present cover works on a 24-volt circuit.

The material used for the covering is 16-oz. wool bat with a face coating of cotton drill and a back covering of cotton muslin. It is quilted, similar to satin puffs on beds. A coating of polyvinyl chloride resin on the exterior material serves to waterproof the cover, while the material inside the cover combines porousness and toughness for good circulation of heat and for resistance to tearing.

Credits—Material: Resin coating, Vinylite. Quilted material, Uxbridge Worsted Co., Inc., and Columbia Ideal Quilting Co. Coating by Respro, Inc., and Permatex Fabrics Corp. Cover produced by Pioneer Products Div., General Electric Co.

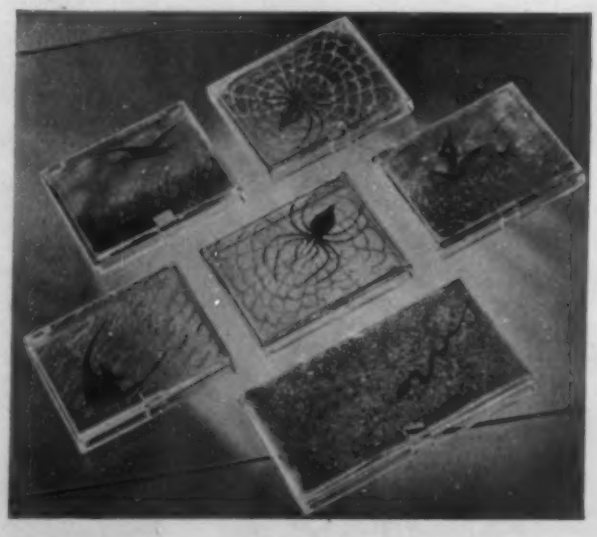
PLASTICS

FROM THE PATIENT EXACTING STUDIES BY a resin chemist of the phenomena of light and air in relation to plastics has come an original three-dimensional decorative treatment for clear plastic surfaces. Called "Mystal" because of the misty, frosty or crystalline effects which are obtained by the process, this new type of ornamentation produces an entirely different texture for plastics and creates sparkling effects.

The unusual soft effects are due to the use—unique in applied art—of the element, air—imprisoned in a multitude of tiny bubbles. These bubbles, whose size and form can be controlled, must be painstakingly directed into definite predetermined patterns since the shape, depth and concentration in area of the air bubbles naturally influence the design. Bubbles may be round, eliptical or tubular in shape, or they can be combined into strips during the processing operation. Backgrounds are produced first over the entire surface and the figures are brought out in relief. The designs, highlighted by the addition of delicate coloring, are permanently infused into the transparent plastic surface. The decoration may be a mere film on the surface of the material or a raised design in various planes.

This relief technique is the result of a 6-year investigation into the evolution and control of air bubbles. While not yet in commercial production, the process has been applied experimentally to the covers of the clear methyl methacrylate cigarette cases.

Credits—"Mystal" relief by Dr. Alexander Winogradow. Cigarette cases decorated for the F. Lunning Art Collection and Georg Jensen, Inc.



THIS CHIC NEW MIRROR BASE AND FRAME, which has been cleverly styled to take advantage of streamlining and is admirably adapted not only to injection molding but also to the most effective use of plastics, serves as an excellent example of the unusual results that can be achieved with plastics when the designer really understands his medium and puts his knowledge to good use.

Measuring twelve and a half inches wide, four inches deep and seven and a half inches high in over-all dimensions, this "Vanity Mirror" is composed of a circular mirror set in a frame and a base of cellulose acetate, which is injection molded in a wide selection of colors limited only by present wartime restrictions. The choice of cellulose acetate material for this application provides the necessary lightness of weight. The mirror, which constitutes the chief component of the assembly, is held in a bezel by a rim that snaps permanently into place. Lugs on the rim fit snugly into hollow bosses in the mirror frame, and hold the assembly tightly without the need of cementing. The resulting effect is a neat and uncomplicated addition to the necessary equipment of a dressing room.

The mirror proper, which has a guaranteed silver coating, measures a full six inches, and is double faced, being magnifying on one side and normally reflective on the other. Two lugs which slip into undersize holes in the supporting arms of the sturdy eight-ounce plastic base provide a hinge for the mirror, enabling it to pivot on its stand so that either side can be used at will without the necessity of turning the entire base. At the same time these lugs serve to hold the mirror firmly at whatever desired angle it may be set.

Credits—Material: Tenite. Molded by Continental Plastics Corp. for Consolite Corp.

PRODUCTS*

ONE PIECE OF EQUIPMENT THAT IS VERY important to bomber crews is a small regulator attached to the portable oxygen cylinders which automatically feed the proper mixture of air and oxygen to the fliers' masks as they move about in planes.

The manufacturer has devised a series of tests to make sure that every regulator works flawlessly. Perhaps the most important test is one simulating the various altitudes at which bombing planes operate. The key to this test is a fabricated box of clear and polished methyl methacrylate. Measuring 9 in. long, 7 in. wide and 7 in. high, the vacuum-tight test chamber is equipped with a removable lid.

A regulator is placed in the test box and oxygen and air piped in in quantities duplicating requirements at various heights. Meters show how much oxygen and air is released by the regulators. Adjustments can be made in the regulators by cylindrically shaped wrenches extending through the inch-thick walls of the box. Bellows-type joints are used for the wall openings and strips of rubber placed around the flanges to keep the chamber vacuum-tight.

Credits—Material: Plexiglas. Box designed by Barnes and Reinecke. Made by Lion Mfg. Corp. for Army Air Forces.

*Reg. U.S. Pat. Off.

IN THE AIR AND ON THE SEA

1—True estimation of the success of an encounter with the enemy demands a knowledge of the type of vessels sunk or damaged. These ship models act as teachers' aids

WHO hasn't listened to the shrill triumphant chant of children identifying a tiny speck in the sky as a P-38 or a B-25; or again, a dark silhouette far off across the water as a cruiser of, say, the Cleveland class. Sometimes they disagree—some claiming it as a destroyer, others as a battleship. But even when the disagreement leads to a fight, it is all soon forgotten and no one is the worse for the mistake.

But for members of the Armed Services, one such mistake may be fatal. Not only must they recognize a ship or plane as belonging to the enemy, but they must know its class and type if they are to gage speed, fire power and maneuverability. To make such recognition almost instantaneous, plastic models of warships,[1] airplanes and cargo vessels are now standard training aids in all services.

If there is such a term as a "miniature-miniature" airplane, it now has been produced by injection molding of cellulose-acetate materials. Though small-scale model plastic aircraft are now an old story, comparatively speaking, it is only recently that production of planes exactly reproduced down to a scale of 1 to 432 inches, has been revealed by the plastics molder who is doing the job and by the Army Air Forces and Navy for which the tiny craft are being fabricated in quantity.

Early in the war, both the Army Air Forces and the Navy ordered precisely-scaled models of all types of Allied and enemy aircraft for study and identification purposes. These were produced in plastics by injection molding to such exact detail that every feature of their armament and construction was shown.[2] In most cases, these models were made to a scale of 1 to 72 inches. And as both the Allies and the Axis added new types of planes to their forces, additional plastics models were added. So far, a total of 135 of the 1- to 72-in. models have been produced.

But small as they are, the original models are not small enough to be of use to pilots and gunners while in the air. In other words, they could not be taken along for "reference" purposes. So it was that the Army Air Forces and the Navy decided that even tinier models were necessary, with the result that every Army and Navy flier now has, spread before him in the cockpit of his plane or readily accessible in his pockets, enough "miniature-miniature" planes to make it a simple matter for him to identify any planes he may encounter.

So far, something like 68 of the new small models have been produced in gray cellulose acetate. In so far as is possible in products so small—the average wingspread is only 1 to $1^1/_8$ inches—all details have been reproduced.

Planes without pontoons or with retractable landing gear are molded in one piece. However, many types either have stationary wheels or floats or other parts which make it impossible to mold them in one piece. In these cases, the various parts are molded separately and subsequently assembled and cemented together.

Four-cavity dies are being employed in molding nearly all the new "miniature-miniature" models—that is, four planes, not necessarily of the same type, are produced at a time. Where "inserts," which may be pontoons or landing gear, are necessary, they are molded as separate pieces.

Newspaper readers have seen bulletin after bulletin in which the sinking of an enemy tanker of a specific class and tonnage are reported. They must often wonder how the eagle eyes of the Navy or the Army Air Forces have succeeded in identifying the type of ship that was sent to destruction.

One way in which this is being accomplished is by the

[1] "A Cleveland-type cruiser," MODERN PLASTICS *22*, 103 (Feb. 1945).
[2] "Campaign for war business," MODERN PLASTICS *20*, 37–41 (Sept. 1942).

molding of small-scale models of enemy vessels. These so-called "teacher's" models are produced by injection molding of gray cellulose acetate on a scale of 1 to 500 inches.

The initial release of these models totaled sixteen types—some United States merchant ships of various types but mostly Japanese. Of the sixteen, there are four passenger ships (or troop carriers) and twelve cargo vessels. And of these last twelve models, three are freighters, two combination passenger cargo ships, two tankers, two cargo vessels, one collier, one trawler and one whaler. The smallest unit in the lot is the trawler, 3 in. long; the largest, a passenger ship, 14 in. long.

The same molder who had piled up a great amount of experience in producing model and miniature airplanes found that making model ships was quite different from molding model planes. He learned that it was necessary to develop what he now calls "a feeling for ships" and is frank to say that the first few wooden models and dies were "really tough."

For sixteen different types of ships, a total of twenty-two dies are used. Sixteen of these dies are for the individual ship hulls while the remaining six consolidate the twenty-four extra parts that are needed on the various models, including lifeboats, vents, masts, and similar accessories.

The ship models are not intended to reproduce exact details of the enemy vessels, but rather to serve as silhouettes that can be identified from sea level or from the air.

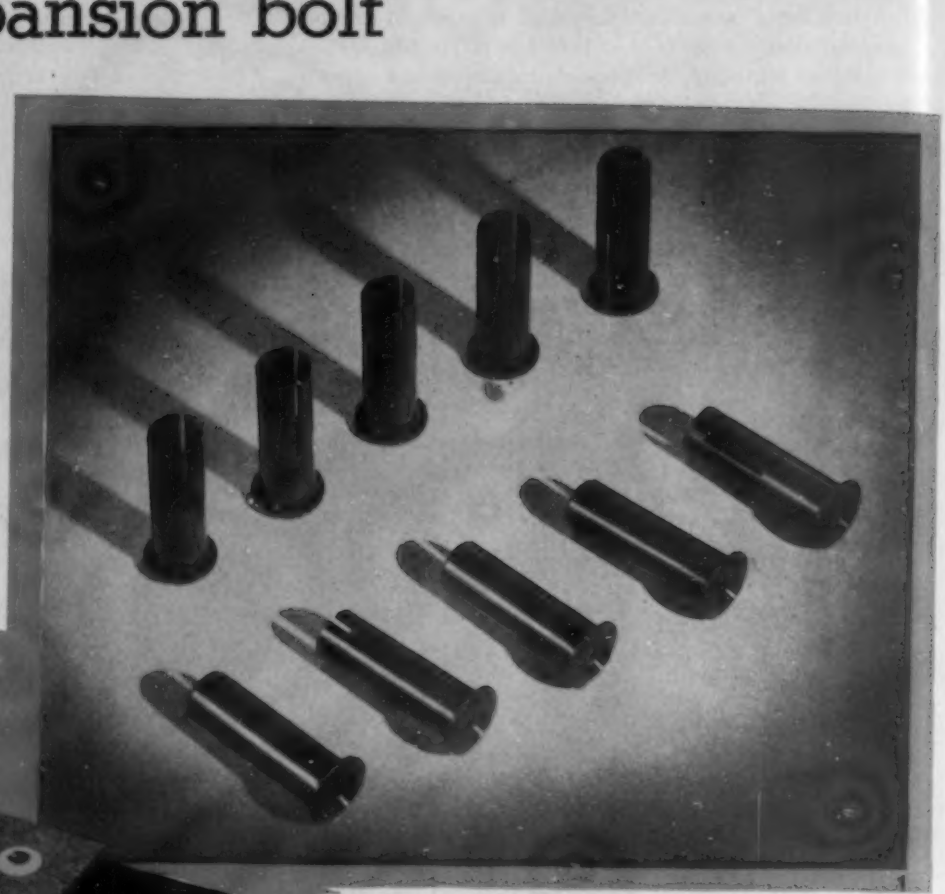
Credits—Material: Lumarith for ships and planes. Molded by Cruver Mfg. Co. for Army Air Forces and Navy

2

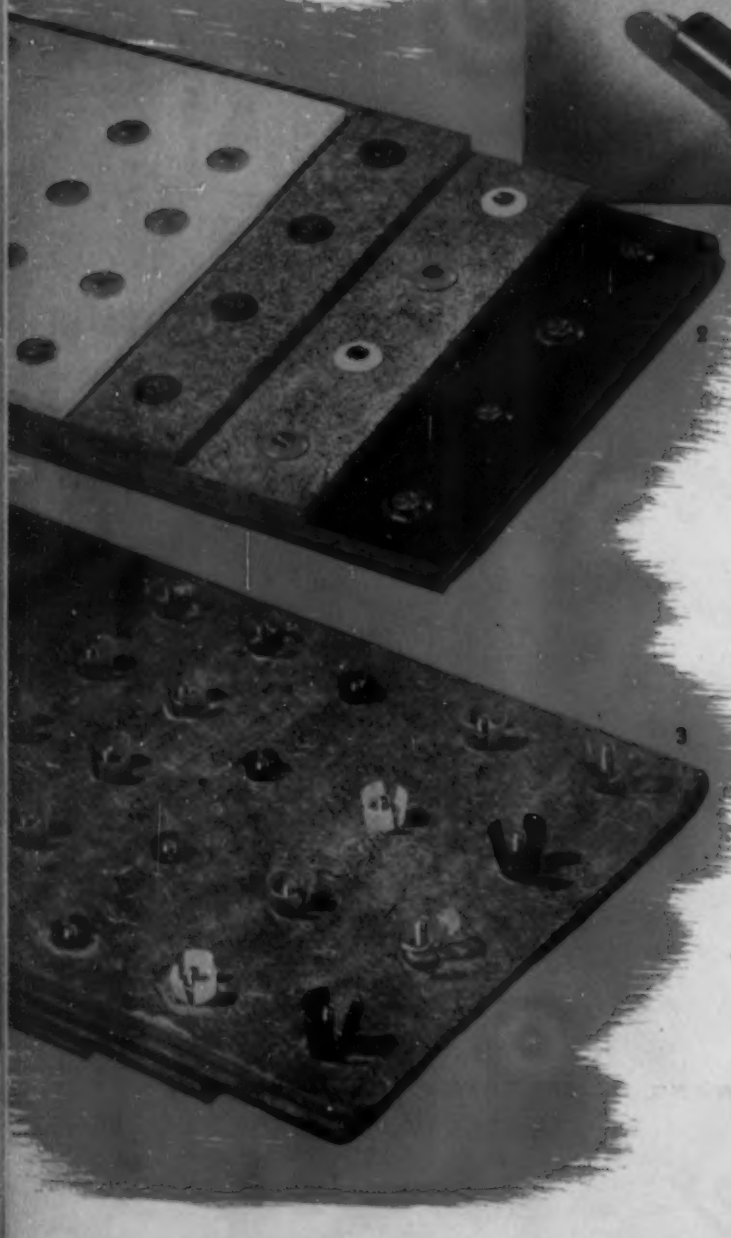
3

2—The actual size of these "miniature-miniature" planes, shown in relation to the 1- to 72-in. scale models, suggests the possibility of their use as reference material by fliers. 3—*More than sixty types of Allied and enemy aircraft have been reproduced in these precisely scaled models*

A blind expansion bolt



1—A blind expansion bolt which enables laminates to be fastened together without marring their surface, has widened their use in new applications. The most important element of the bolt is this plastic sleeve. **2** *and* **3**—*This series of laminates held together by the bolt (Fig. 2, top side and Fig. 3 underside) suggests the wide variation in thickness now possible in assemblies*



THE fastening of laminates constitutes a serious problem to designers and engineers who are eager to employ these new plastic materials but find themselves critically hampered by customary methods of construction. In a majority of the cases where this material is proposed as wall paneling, the surface of the laminate is too hard for nails and screws. Furthermore, its gleaming finish is in constant danger of being marred by blows of the hammer or by the insertion of ordinary fasteners. Often the use of laminated tubes and tees must be abandoned because the interior of these sections are inaccessible to the wrench, and thin sections cannot be fastened together successfully without an anchoring support.

One solution to this problem lies in the use of a plastic blind expansion bolt. This fastening device, like the blind rivet and blind grommet developed by the same company, is very simple in construction, economical in use and dependable upon installation. It consists of a plastic sleeve assembled with a bolt and nut. Throughout its development the designers kept in mind their objective of constructing a fastener that even an unskilled workman could apply. All that is necessary to achieve a permanent fastening is to insert the fastener in a drilled hole and turn the bolt with a common screwdriver.

The plastic sleeve (Fig. 1), the most important element, structurally, in the entire fastener, is unique in that it has three triangular-shaped, knife-like fins molded around the outside periphery of the flange. These fins, extending from under the flange at one end of the tube and tapering off until they join with the body of the sleeve, are designed to bite into the material in which the bolt is being inserted.

Another feature of this plastic sleeve is the way in which the insertion end is divided into three finger-like prongs by grooves

molded through approximately three-quarters of its length. It should be added that each sleeve has an inner taper, which begins about halfway down each of the fingers. When the nut is assembled in place and the screw is turned, these are the two elements that prevent the nut from turning and make possible the drawing together of the sheets being assembled.

As can be seen in Fig. 4, even before this expansion bolt is inserted in the hole that has been drilled for it in the laminate, the bolt is slipped inside the tapered sleeve and the nut screwed on to the lower threads. Since the nut is smaller across its face than the diameter of the plastic sleeve, the unit, thus assembled, passes easily into the opening prepared for it. With the first turn of the screwdriver, the knife-like wedges at the head, bite into the material being assembled—and the sleeve is thereafter prevented from turning. At the same time the inside taper of the sleeve and the finger-like construction of the lower section of this tube hold the nut firmly in position. As the bolt is turned still further it draws the nut up along the fingers and deeper into the tapered sleeve. Finally, when at last the laminates are tightly assembled, the prongs of the body of the sleeve are spread back against the underside of the sheets (Fig. 5).

Since there is no standard thickness for assemblies of this type, the plastic expansion bolt was so designed that the total thickness of the sheets may vary as much as one-half the length of the sleeve. This characteristic may be attributed to the inner taper that is a feature of each sleeve. Because of this construction, the locking action takes place at whatever point the wedging action is complete. And this does not represent the full leeway possible when these fasteners are used. Not only is each sleeve usable on laminates up to one-half its length, but the sleeves are available in several lengths. Perhaps the clearest picture of the great variation in thickness that is possible in assemblies of this type can be gained from Figs. 2 and 3 where the depth varies from $^{13}/_{16}$ to $^{1}/_{4}$ inch. These illustrations also show the appearance of the plastic blind expansion bolt after assembly—Fig. 2 being the top side of the assembled laminate and Fig. 3 the underside.

In addition to the speed and ease with which these expansion bolts can be assembled, they have another important virtue. They can be applied by one man. As has been explained, the nut is threaded on the screw prior to the insertion of the unit in the hole that has been drilled for it. Since the construction of the sleeve is such that it grips the nut and thus prevents it from turning, there is no necessity for a second person to assist. And even more important than the saving in labor is the broader field of application made possible.

It is apparent that this fastener, while particularly suitable to the field of laminates, can also be used with many other materials. Sheets of glass need not crack from contact with metal screws when this bolt in its plastic jacket can fasten them with an equally firm grip. Furthermore, in molded plastic construction, a fine unity of structure and appearance results when the sleeve of the bolt is made of the same plastic as the surface to which it is applied.

One of the major uses for this bolt will, no doubt, be in prefabricated housing, for it offers a fast way of putting a structure together. On a wall panel with a beautiful and permanent plastic finish it is desirable to have a fastener that blends with this modern material in color and character.

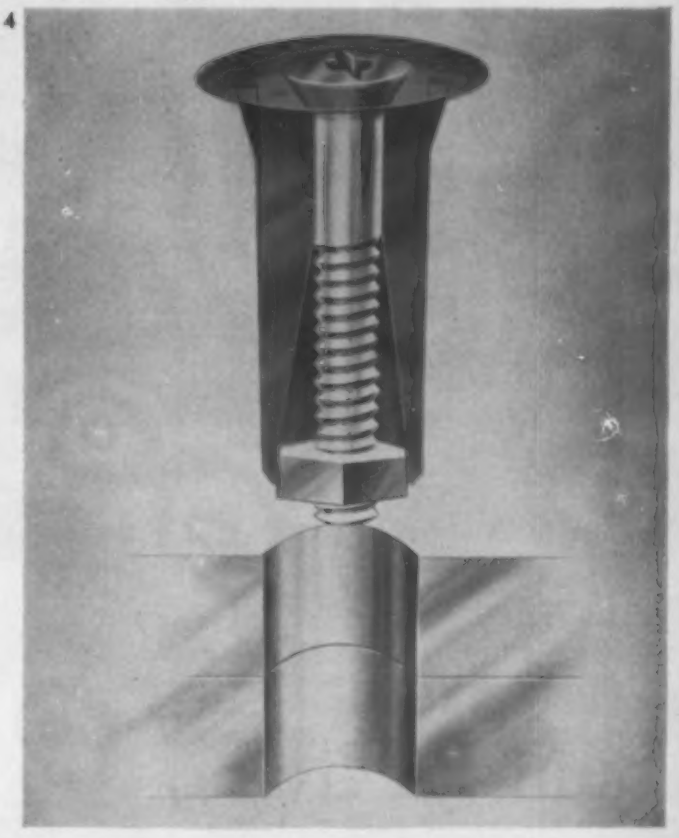
On a trailer, which needs light but tough construction, the plastic blind expansion bolt is again a useful fastening device. After the laminated structure is completed, a finishing panel can be applied from one side when this fastener is used. The locked nut insures a permanent hold where a screw or nail might eventually shake loose. For a boat the fastener must be waterproof as well as shakeproof. By the simple application of a drop of solvent the bolt can be cemented in place at the same time it is locked into the construction.

Credits—Developed and molded by Victory Mfg. Co.

4—Before the bolt is inserted in the hole drilled in the laminate, it is slipped inside the sleeve and the nut screwed onto the lower threads. Three fins on the outer periphery of the sleeve wedge into the sides of the hole to keep it rigid. 5—As the laminates are assembled by the bolt's wedging action, the sleeve fingers are spread back against the under side of the sheets

DRAWINGS, COURTESY VICTORY MFG. CO.

4



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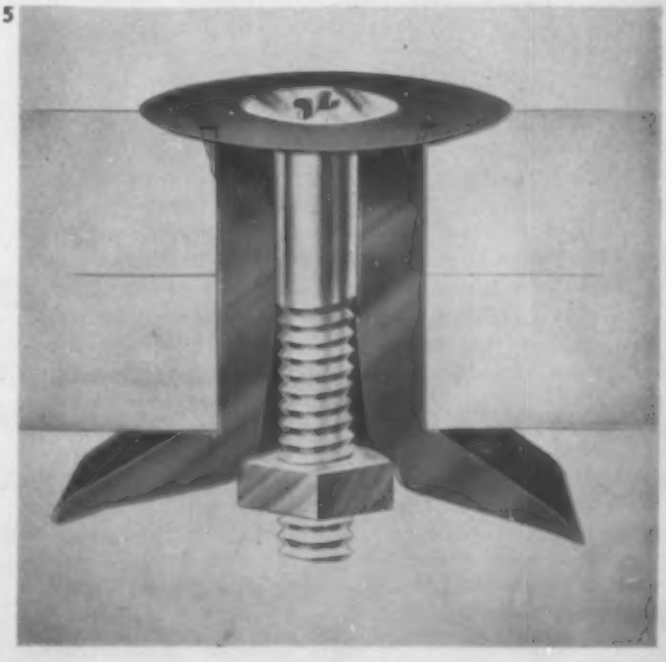

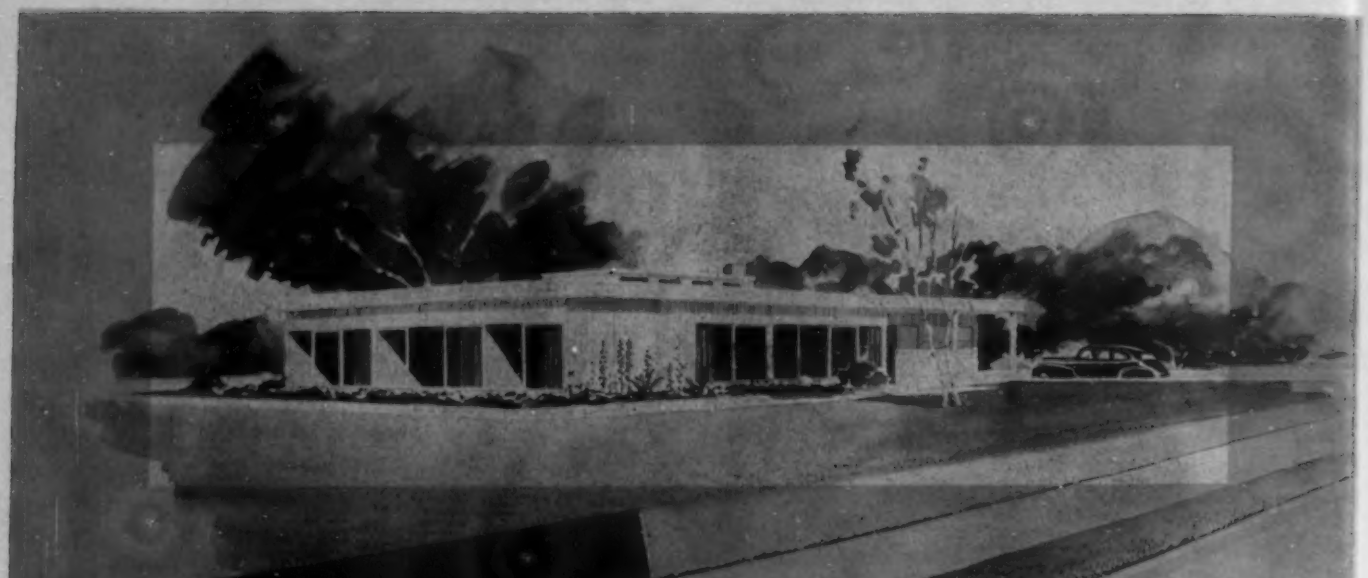

2 1

1 and 2—First prize in the Second Annual Small House Competition, which went to Lt. Charles D. Wiley, calls for a simple plywood home divided into 4 zones: a domestic center, an activity center, a quiet zone and a flexible space for sleeping. A mechanical "core" was specified, which would include all plumbing and heating, cooking, refrigeration and laundering facilities. This would be located in the center of the house

Built for living

by VERNON F. SEARS*

RECENT developments in the field of plastic resins have resulted in a veritable revolution in the plywood industry since for the first time it has become possible to bond veneers to each other in such a manner as to form an unassailable product which can be used for either indoor or outdoor use. However, the plywood industry itself will not be completely satisfied until all plywood is produced in such a form that it can be used for both indoor and outdoor uses. This program calls for a lower-priced plastic, one which will be capable of polymerizing more rapidly than those which are already in use for this purpose. Plastics have also been found to be most effective as impregnants since they serve to increase the basic hardness of the wood and to protect it both from weathering and borers. Sufficient work has already been done along these lines to indicate that bond, color and finish can be readily achieved within the compass of a single operation. Too, surfacing with impregnated paper and plastic ply metal is now a common practice in the industry. The renaissance of plywood, and its application to many hitherto untouched fields has resulted from its propitious union with plastics.

LAWRENCE OTTINGER.

WHATEVER differences of opinion there may be regarding the period of time which will elapse after V-Day before the construction industry gets into stride, there is no question as to the important role new housing will play in the postwar economic picture.

It is for this reason that so much interest has been centered upon the results of the Second Annual Small House Competition of the magazine *Art and Architecture*, co-sponsored by our company—a contest that attracted entries from several hundred American architects and designers.

If, as generally predicted, the objective of postwar housing will be the achievement of more gracious living for the largest number of qualified people, even in the modest income brackets, the results of this competition merit recognition because they reveal the essence of the collective thinking of many specialists.

Contemporary planners of housing are firm in their belief that existing systems of construction can be adapted to

* Staff architect, United States Plywood Corp.

embrace factory-built service and structural units. The competition also disclosed that many architects are convinced that there can be standardization of certain sections of the house without "monotonization." Scores submitted plans using a module or "standard part" system, yet no two of the proposed houses were much alike and each afforded opportunity for a free expression of individual taste.

Although no restrictions were placed upon materials (the only condition was that the plans be of such a nature that the houses could be built in the immediate postwar period), an overwhelming preference was expressed for the use of plywood in almost every portion of the house.

More than 90 percent of the modern plans that were submitted used plywood for exterior walls, interior walls, ceilings, decorative panelling or built-in fixtures. The standard 4 by 8 ft. sectional panels were almost always shown to be constructed on both sides of stressed skin and plywood, stiffened in some cases with molded plywood corrugations to create wall sections of marked strength and durability.

Molded plywood was also used in the form of molded cylinders, employed as supporting columns and as horizontal stiffeners through which wiring or plumbing cuts could readily be installed to reach all sections of the house. A modification of the molded cylinder was a hollow fluted plywood column. Stairs and curved sections of walls and corners were also made of molded plywood and the use of plywood for sub-floors proved popular.

Taking a leaf out of the modern construction methods for bridging large unobstructed open areas with laminated members, some contestants suggested a combination of this type of construction and plywood. One proposed a laminated cantilever truss to sustain the entire weight of the house roof. Two others presented a square house supported by a central steel column, with crossed laminated plywood members spread out like the ribs of an umbrella.

The first prize plan calls for a simple plywood house divided into four zones: 1) a domestic center with space for cooking, eating, laundry, sewing and child tending; 2) an activity center where the family can make a mess and leave it; 3) a quiet zone, always in order, which is used for rest and conversation—it has the fireplace, music, books; and 4) a flexible space for sleeping which can be broken up into small cubicles or extended in size by the moving of cabinet separators.

In this house, as in nearly all of the other rating plans submitted, recognition was given to the great need for a mechanical center for the small dwelling. The winner specified a mechanical "core" which includes all plumbing and heating, cooking, refrigeration and laundering facilities.

As with the first prize plan, the second prize winner uses factory-built basic service units in order to take advantage of industrial mass production in the interests of economy. This house was designed for a 60 by 120 ft. lot with two enclosing courts to give additional recreational and living facilities and to provide complete privacy for the inhabitants.

This plan, too, envisions a simple plywood house, with mechanical services packaged into a unit which can be factory-built and delivered to the building site and simply attached to the rest of the house. It uses a simplified method of construction based on the known principle of the three-hinged arch, utilizing laminated wood arches to take advantage of modern sheet material.

The third prize plan calls for a plywood molded panel house in which "the moments of inertia are exploited to the maximum." The house has a molded roof, panels, doors and walls—the strength and stiffness of each element being in proportion to the use requirements. The plan calls for factory fabrication of all units, including the kitchen, laundry and bathroom; and the house is divided into living space, sleeping space and service space. The plan exploits molded plywood to the fullest and presents a new evaluation of it as a plastic.

Mention should be made of the molded plywood counters, wall seats, fixed and movable tables, attractively curved chairs and benches, bookcases, music cabinets and shields for indirect lighting indicated in a number of the plans.

The adaptability of plywood for small-house construction, emphasized so overwhelmingly in this competition, tended to center interest on another factor not so generally known, namely, that standardized plywood beams, under the stress of wartime requirements, have also been used satisfactorily in heavy construction.

DRAWINGS AND PHOTO, COURTESY UNITED STATES PLYWOOD CORP.

3—The house winning second place, designed by Lt. (jg.) Russell M. Amdal, also contemplated plywood as the construction material. Specifications called for the use of factory-built basic service units

Spirit level

1

2

1—Differently colored fluids in each of the six angles indicated on this acrylic spirit level not only add to the beauty of the instrument but make it easier to read. 2—The transparent indicating disks are marked for 22½, 30, 45, 60, 90 and 180° angles

A SPIRIT level is part of the stock in trade of the plumbing and heating business as it is of all work where the precise location of equipment in relation to the horizon is a matter of concern. What could be more logical then, than that this transparent acrylic level should be the development of a plumbing and heating engineer. The instruments these units are designed to replace, assemblies of glass tubes set in metal or plaster of Paris, are liable to breakage and are easily bent—thereby made useless. In contrast, this new plastic spirit level gives the workman a tool that is fixed and precise despite the rough handling to which it is subjected, easy to read and an object of real beauty.

Six different angles are indicated on this transparent acrylic spirit level—22½, 30, 45, 60, 90 and 180° (Fig. 1). So that there can be no error in identifying these different angles, the instrument is designed with a double check system. First, figures giving the degree of angle are engraved in color on the outside surface of the plastic vials that hold the indicating fluid. As the second precaution, and to add beauty to the instrument, fluids of different color are employed to designate the different angles. Thus, orange is used to indicate the 22½° angle on this acrylic spirit level, green for 30°, purple for 45°, blue for 60°, red for 90° and yellow for 180°.

Seven parts from one mold

Seven parts—a body and six vials—go into the assembly of this spirit level. So that all the parts can be molded at the same time, a seven-cavity combination mold was worked out for this instrument (Fig. 4). The complete molding cycle is approximately 90 seconds. The hole in each of the small vials, designed to hold the indicating fluid, is curved on an 8 in. radius. Because the curves are identical on all the plastic disks, the six pins that form the holes can be withdrawn on the same radius. The side pulls that withdraw the six pins from the vials operate mechanically with the motion of the press and all are removed at the same time. The design of the seven parts calls for a $^{5}/_{1000}$-in. taper on the side wall of each of the vials but no taper at all on the corresponding holes in the body of the instrument.

Upon removal from the injection machine, the body of the spirit level is cut away from the shot, leaving each of the six vials still fastened to its respective runner. The next operation is the filling and plugging of these vials prior to their insertion in the body of the spirit level. The equipment that has been developed for this work not only fills each cavity with the proper amount of the correctly colored liquid but stamps out plugs for the hole in each vial and forces them into proper position.

Filling the indicating vials

The six runners and vials are assembled in a jig so that the hole in each vial is directly beneath a pipette arrangement. This filling device transfers the correct number of drops of fluid to each vial. Then the jig assembly is placed beneath the plugging and sealing unit. This latter device has six tiny punches and dies which, in one operation, stamp out the six tiny disks that fit perfectly over the holes in the vials. One drop of solvent is then deposited on the top of each disk—permanently sealing the correctly colored fluid inside each of the transparent vials.

The liquid that is used in these vials is a very high viscosity oil that has a boiling point of 390° F. and will not freeze until

the temperature goes below −80° F. Standard soluble dyes are used as the coloring agent.

Upon the completion of this operation, the vials are cut from their runners and wet sanded to remove all trace of the gate. They are then buffed on a standard buffing wheel. In the case of the body of the spirit level, after the gate has been sawed off the part is set up on a vertical miller and the flat bottom or indicating surface precision milled to perfect flatness. When additional finishing work is necessary on the parting line of the body or on the vial, the pieces are wet sanded and lightly buffed.

Special assembly fixture

A special assembly fixture, hydraulically operated, is employed to assure the proper assembly of the six vials in the transparent body of the level. By proper assembly is meant the precise location of the indicating tube in each of the vials in relation to the horizon. In other words, the vial marked 30° must be so positioned that the tube containing the indicating liquid is at exactly a 30° angle in relation to the bottom of the body of the level. To facilitate this assembly, each vial has a small indicating pilot molded in the side which assures the correct location of this piece in the assembly fixture both as regards its position with relation to the other vials and to the bottom of the body part. All six vials are assembled into the body of the spirit level in the same operation, at the same time. The tolerances on the outside diameter of the vials and the inside diameter of the body are such that no difficulties are experienced when the parts are assembled—the bodies have not broken or cracked and the vials have not been found to slip out of position. Because of the close tolerances that are maintained in the molding of all seven parts, no adhesives are required to hold the vials in place. In consequence, the unit retains the perfect clarity of the base material—acrylic.

Seventeen months were devoted to the development and engineering of this spirit level. But the result, as can be seen in Fig. 1, fully justifies the effort. In working out a practical easy-to-use and durable instrument the designer has achieved a most attractive plastic application which should prove popular in all types of work involving angles.

Credit—Material: Plexiglas. Molded by Sobenite, Inc., for Lawco Plastic Products Co.

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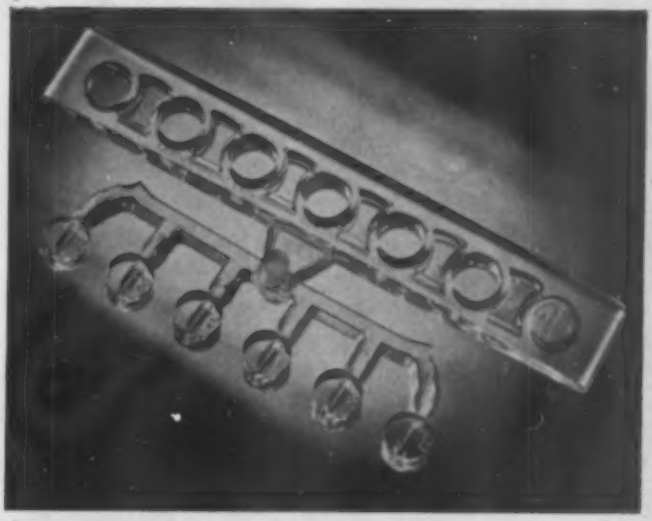
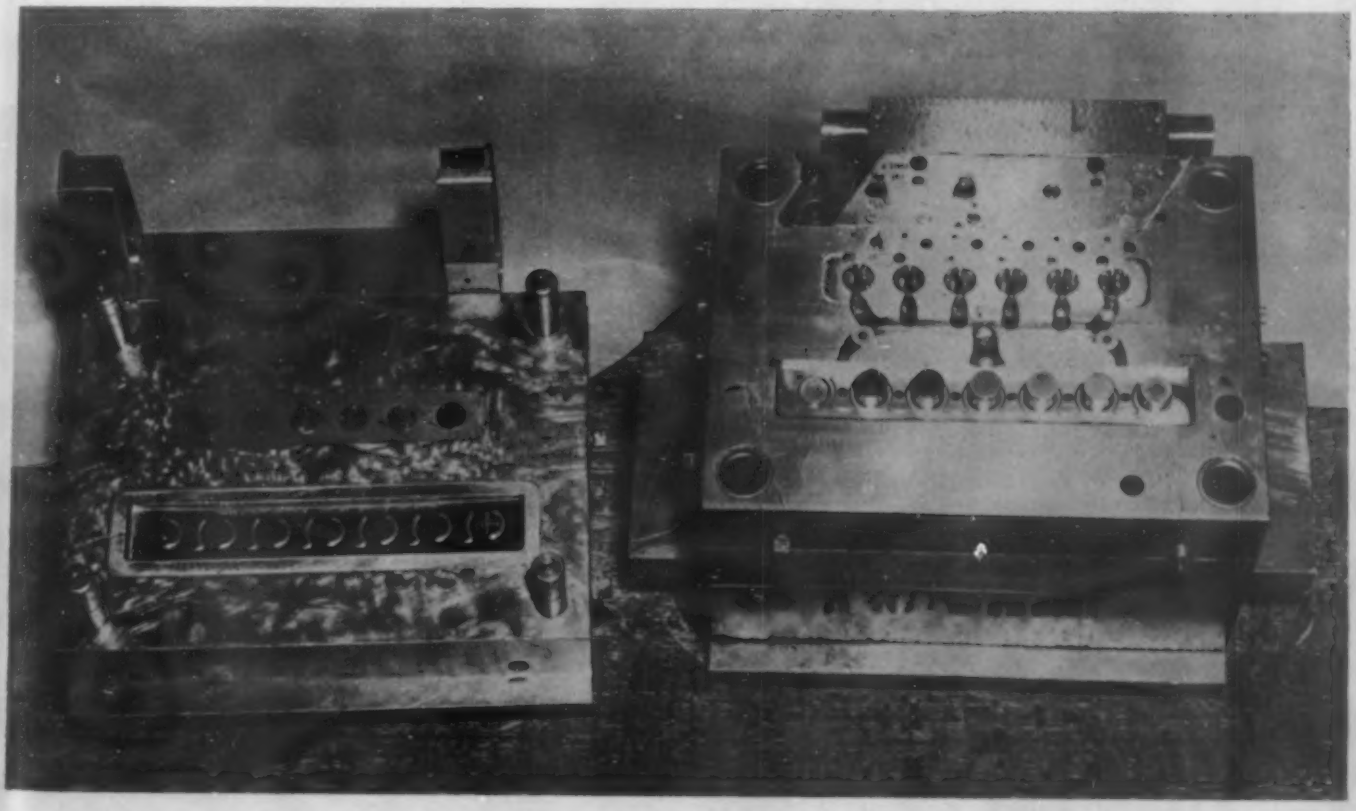


3—All seven parts that go into the assembly of this spirit level—a body and six vials—are molded at the same time in a seven-cavity combination mold. The hole in each of the small vials, designed to hold the variously colored indicating fluid, is curved on an 8-in. radius. Because all the curves are identical, the six pins that form the holes can be withdrawn on the same radius—the side pulls operating mechanically with the motion of the press.

4—This combination mold produces the seven acrylic parts that comprise this newly developed spirit level

4 PHOTO, COURTESY LAWCO PLASTIC PRODUCTS CO.



Plastics in Review

1

1 With thousands of vehicles of war shipped daily as deck cargo on merchant ships, the problem of keeping them in good condition presents a constant headache. One means of preservation is to seal the crevices of the machinery with Industrial Tape Corp. Utilitape. This tape consists of a Revolite fabric manufactured by Tapon-Keratol Div., Atlas Powder Co., impregnated with special Bakelite flexible resin, to which is added a strong adhesive agent

2 To dispel the distinctly utilitarian aspect of lighting fixtures, Plastics Creations of Hollywood have designed a series of wall lamps with highly decorated Lucite shields and brackets which produce a crystal clear effect. These attractive lamps, which may be obtained with or without the upper plastic shield, are definitely modern in design

3 A new technique of molding high-impact Bakelite to electro magnet cores has been developed by R-B-M Manufacturing Co., Division of Essex Wire Corp. Sealed barriers are provided between coil windings and cores without deforming them, enabling the finished bobbin assemblies to withstand extreme limits of temperature without failure. Since the cores are often used in extremely humid climates, such a precaution is a requirement in their manufacture

4 Designed to match the tradition of beauty which it serves, this tiny rouge case of white cellulose acetate is a worthy addition to the field of cosmetic containers. Injection molded in 2 parts by Bernard Edwards Co., the case has a patented hinge, eliminating the need of a pin. Prince Matchabelli, Inc., uses the case for its Duchess of York line. Cover design by Duff Gordon

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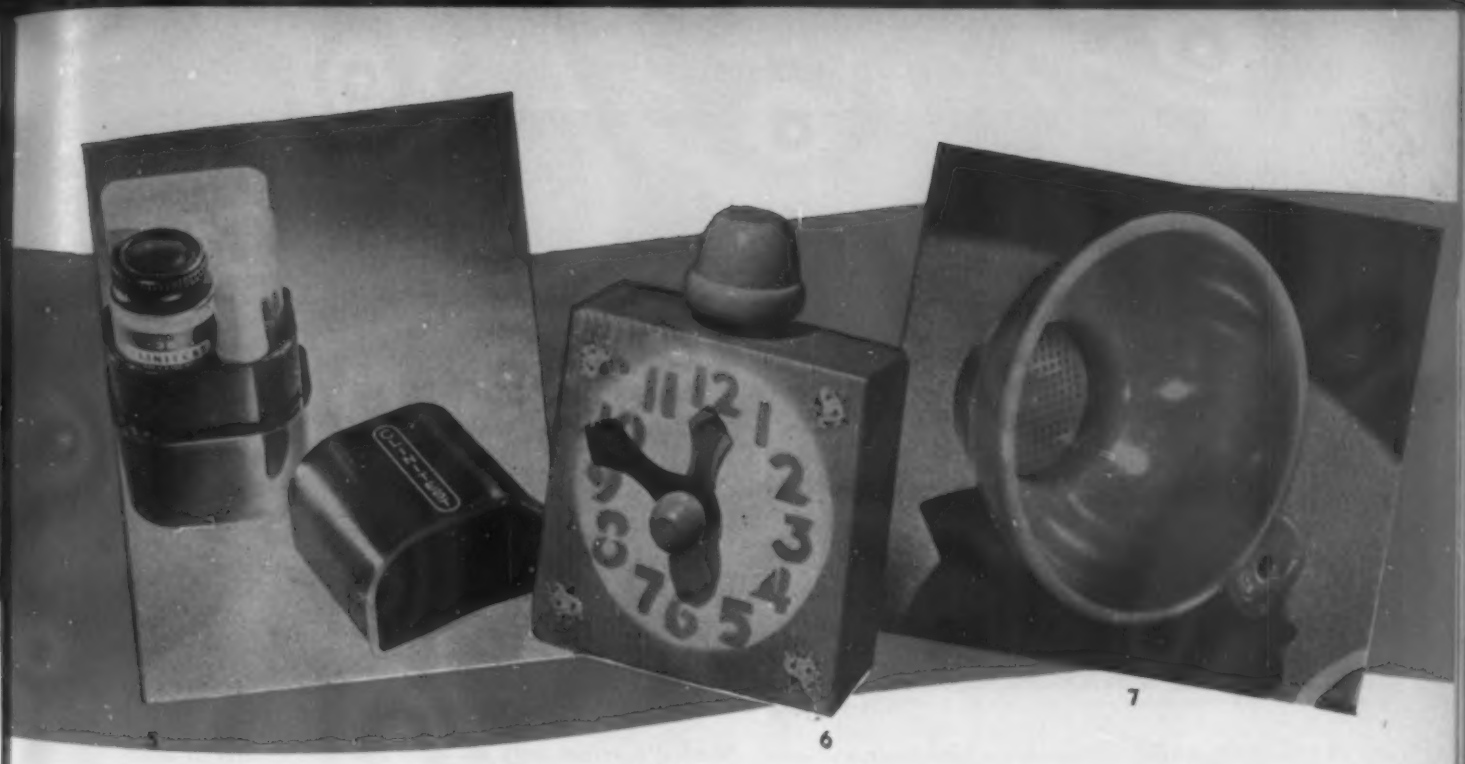


5 6 7

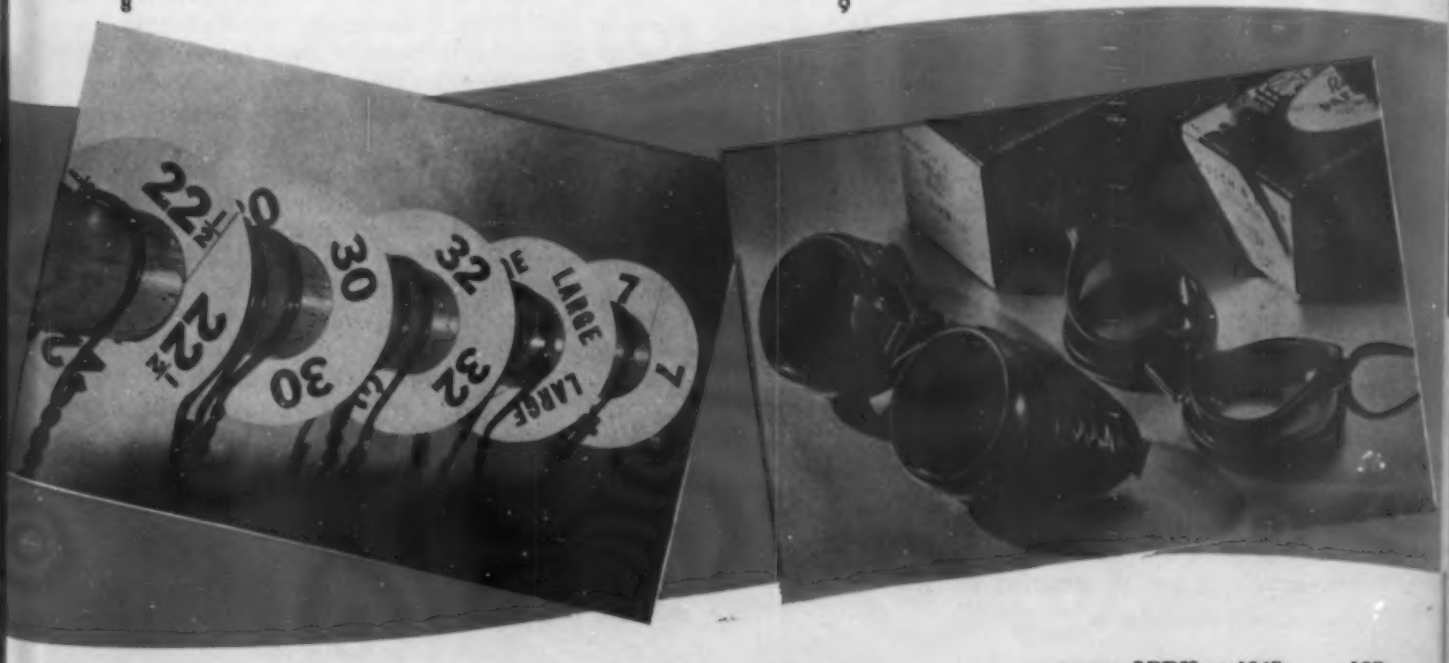
5 For those who must be constantly on guard against any increase of sugar content in the system, Ames Co., Inc., provide a pocket size Clinitest set in a streamlined case of Tenite II molded by Elmer E. Mills Corp. This compact copper reduction test for urine-sugar also employs a color scale which is plastic coated as a protection against constant wear

6 Learning to tell time can become a fascinating game for children if these toy clocks manufactured by Higgins Mfg. Co. are used. Made of wood with a conventional dial face, the clock has movable Lumarith hands. The back of the clock has 3 rotating disks of cellulose acetate dyed in three primary colors for the teaching of color. Plastic parts fabricated by Aircraft Die Cutters

7 With ration points at a premium, housewives have turned to the canning of fruits and vegetables to conserve coupons for scarcer commodities. This rustless and shatterproof utility and canning funnel molded of red Tenite II by B. W. Molded Plastics will, therefore, be a welcome addition to their kitchens

8 The time-consuming and often annoying task of searching long racks of dresses for labels to determine the size of a garment is alleviated by the use of Lumarith garment rack dividers. Fabricated by Parisian Novelty Co., the dividers have the sizes printed on both sides for convenience and are easy to clean

9 The constant hazard from flying steel and dirt particles is minimized for machinists with two new types of Bausch and Lomb Optical Co. safety goggles—"Arc Ban" and "Chip Ban." The first, a cup type coverall with eye cups molded of high-impact Durez can be worn over regular spectacles. The second which also has eye cups of Durez molded to fit the contours of the face, is designed for protection against heavy fragments. Auburn Companies, Inc., mold the eye cup and rims for both types of safety goggles



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PHOTOS, COURTESY CORDO CHEMICAL CORP.

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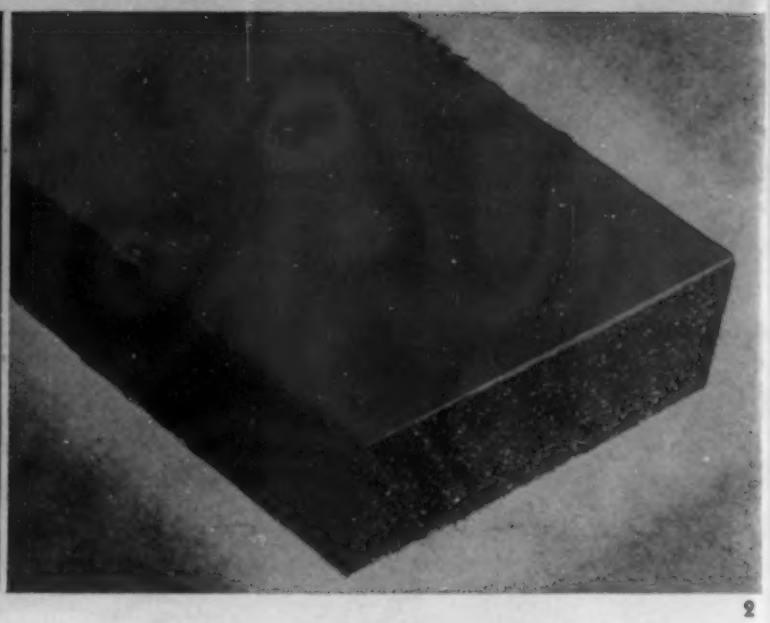

2

1—Such dissimilar materials as aluminum and birch, bonded together with resinous adhesives, have a bond strength greater than the shear strength of wood. 2—Sandwich compositions of aluminum and butadiene copolymer sponge, bonded together with plastic-base adhesives, combine strength, rigidity and light weight

Adhesives—new materials and practices

by BASIL P. GRAY*

WHILE adhesives and glue are as old as history and so simple that a small child can use them successfully to mend a broken toy, the formulation and use of plastic adhesives is an entirely different matter. Yet achievement of a proper understanding of the great difference between these two types of adhesives is essential if industry is to make full use of one of its most valuable tools. For if correct practice is followed in the selection and use of plastic adhesives they may be used in place of rivets, screws and bolts on brittle materials or thin metals, to bond large laminated areas, and to bind together dissimilar materials with a strength which is frequently equal to or in excess of that obtained by other bonding methods.

To obtain these results it is necessary, first of all, to dissipate the rather generally held idea that plastic adhesives are in any way synonymous with glue or paste. Publicity and advertising have stressed the exceptional strength and durability of plastic bonds. Hurried reading of the headlines on this publicity and advertising all too frequently leads to the erroneous belief that these miracles of strength and durability can be obtained with as simple a technique as that which characterizes glue and paste applications.

It should be understood that almost every industrial bonding or adhesive job represents an individual case with definite —and different—requirements. Consequently, in most instances specific resinous bonding adhesives and techniques must be developed in order to meet the specific need of each application.

Over the course of the years, the past few years in particular, many new materials have been introduced to manufacturers, architects and construction engineers. Combinations of these materials—plastics, metals, wood, etc.—possess valuable properties as well as being pleasing in appearance. However, the new construction techniques involved in the practical use of the new materials with the old cannot always be met by the use of traditional glues or long-established rivets, screws and bolts. On the other hand, it is entirely feasible to formulate a resinous adhesive so balanced as to allow for all the factors, such as sensitivity to heat, solvents and pressures, that may be inherent in any or all of the materials which are to be bonded.

With the production and testing of such adhesives, excellent results are assured *provided* application procedure, just as "hand tailored" as the adhesive itself, is followed. Often a change of equipment and close control of the bonding cycle is required. Usually the new procedure necessitates some change in the production routine. Unless a manufacturer can overcome his natural reluctance to invest in additional equipment or make some changes in procedure the new technique of putting things together with plastics is not for him.

A now quite widespread bonding operation involving the lamination of sheets of cellulose acetate to metal is a typical example. A wet solvent-type adhesive is unsuitable for bonding large areas because of wrinkling, caused by the attack of the solvent on the plastic. Furthermore, full bond strength is reached only after the solvent is entirely eliminated—a time-consuming operation where large non-porous areas are involved. The difficulty can be overcome by drying a solvent-type adhesive on the exposed surfaces, then pressing the sheets together at a temperature that is high enough to allow the adhesive to soften and seal. However, this represents only one step toward a final solution of this adhesive problem. During the (*Please turn to page 200*)

* Chemist, Cordo Chemical Corp.

PLASTICS*
Engineering Section
F. B. STANLEY, Editor

Blow molding

by JAMES BAILEY*

THE molding of hollow articles by using fluid pressure is an old art, but it has undergone more or less radical developments in recent years and is now beginning to open up new and interesting fields for those who look with an eye to the future. The art may be roughly classified into three general fields as follows:

The indirect method—An existing shape such as a rod, sheet or tube is blanked out, reheated, blown to final shape.

The diaphragm method—More recently, preforms are built up from pieces and blown to final shape behind a rubber diaphragm. This method is commonly used to build up laminated structures in which the flow is almost zero, and is commonly known as "bag molding." Such molding is not "blow molding" in the sense used in this paper and is, therefore, omitted. One variation in which a rubber diaphragm is held in contact with the plastic and is blown with it, thus controlling the stretch, is a legitimate part of blow molding and is briefly included.

The direct method—In this method, molding powder is made plastic, then formed into an appropriate intermediate shape and blown into final shape in a rapid sequence of operations.

Basic comparison of the three methods

These three methods may be further distinguished by their objectives. The objective of the first is to change, modify or refine the shape of some stock item. The objective of the second is the same, with the added requirement that better distribution must be obtained. The objective of the third is to produce items by low-cost, mass-production methods.

All three of these methods have advantages and limitations which, in some cases, make it difficult to choose the most economical method. The general sequence that is followed in forming the final object is, of course, very similar in all cases. First, the plastic must be made soft and stretchable by the application of heat or solvent. Next, it must be formed to shape and solidified against the mold. Finally, it must be removed from the mold. Trimming, finishing or assembly may be required to produce the finished part.

In the older forms of blow molding such as used in the manufacture of toys from nitrocellulose sheet, two sheets of plastic were placed between the halves of a mold with a small air tube leading between the sheets. The halves were then pressed together and heated while air or steam was blown between the sheets. The pressure of the air between the sheets caused them to blow out against the sides of the mold as the plastic softened. At the same time the pressure of the mold halves around the rim of the cavity, coupled with the heat, caused the two sheets to seal together and thin down around the edge of the cavity. Pressure was maintained between the sheets until the mold was cooled sufficiently to permit removal of the plastic. The articles were then trimmed from the sheet.

The entire cycle, which included time in which to heat the molds and cool them again, was a comparatively long one. Moreover, there was always danger of warpage of the expensive molds if cycles were pushed up to the limit. Modern high-production cycles use hot plastic and cool molds, and such cycles can be run at rates higher than 30 cycles per minute when using 0.010-in. sheet stock. Unfortunately, the utilization of the sheet stock is seldom more than 50 percent, a factor in the cost which cannot be overlooked.

The rubber diaphragm method is avoided wherever possible on thin, low-cost articles since the diaphragms do not stand

* Vice-president and director of research, Plax Corp.

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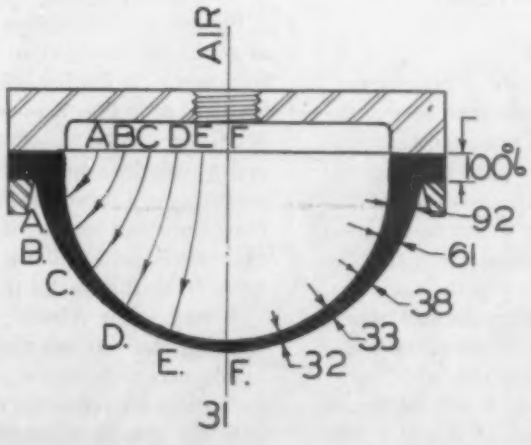

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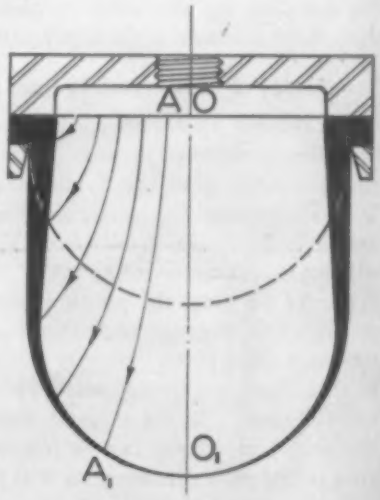
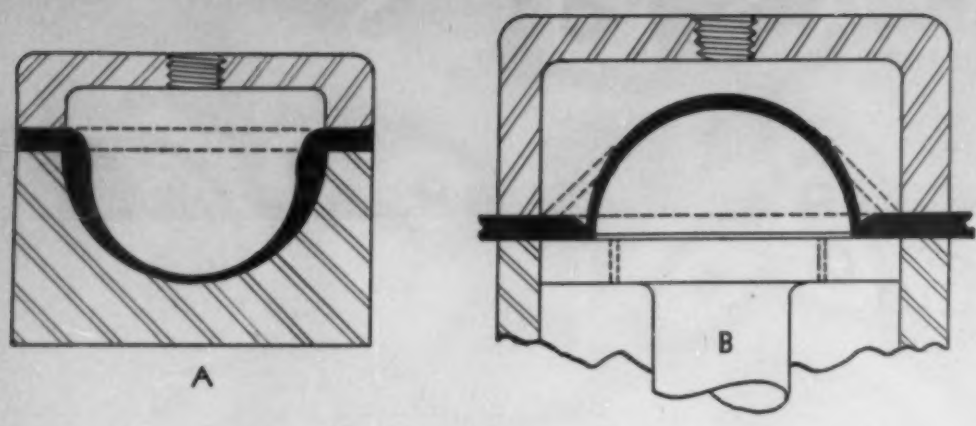


Flat sheets blown at constant temperature. **1**—*When blown to a hemisphere, the wall section varies as shown by the percentage figures on right quadrant of this figure. Letters A through F indicate movement of actual points on the plastic surface.* **2**—*This drawing shows the movement of these same points as the sheet is blown past the hemisphere stage to almost the elastic limit of the material*



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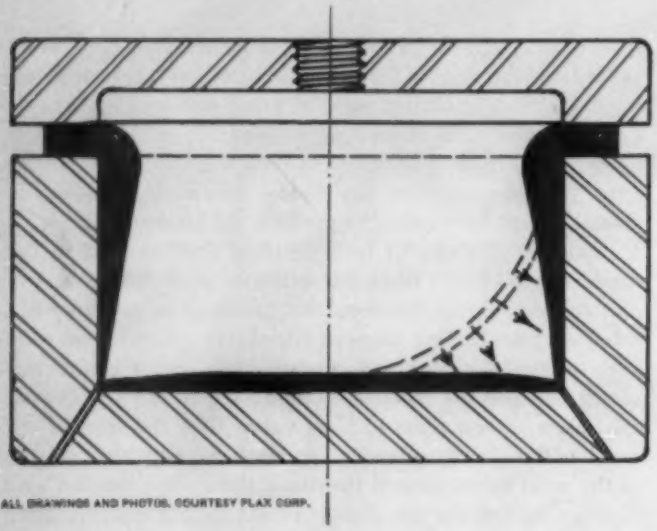
3—Drawings A and B show how a difference in the direction of approach of the sheet to the mold affects the thickness distribution. 4—This sketch shows approximate distribution obtained when a flat sheet is blown into contact with the walls of a flat-bottom cylindrical die



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ALL DRAWINGS AND PHOTOS. COURTESY PLAX CORP.

up very well, and the cycle is much longer. The method is particularly useful in forming large, heavy-gage sheets (1/8 to 3/8 in.) where the requirements are stringent and cost is a secondary matter.

Since the third, or direct method, is a mass-production process, it is chiefly applicable to articles of the general character of bottles, although such large-sale items as Christmas tree balls, salt shakers, toilet floats, special collars with threads, and an assortment of specialties have been made. It has not been possible to achieve quite so good an appearance on some items as can be obtained when they are made from sheet stock, and the distribution of wall thickness is not so perfect in some shapes. Nevertheless, the variation works out to be an advantage in many cases, and it is possible with this method to make articles cheaply and easily—a virtual impossibility by any other method. The subject will be more fully discussed in the latter part of this paper.

Mechanics of blow molding from sheets

If a sheet of plastic such as cellulose acetate or polystyrene is uniformly softened by heat and its edges clamped between a ring and cover as in Fig. 1, and air at the same temperature is blown between the plastic and the cover until the original flat sheet becomes a hemisphere, the stretching which results will cause a decrease in thickness. Owing to the restraining action of the ring, the plastic immediately adjacent to it is prevented from expanding radially, and very little change in thickness takes place. Shortly below the ring, the wall begins to thin down rapidly and reaches about one-third of the original thickness. If the original sheet is marked with lines, the actual movement can be followed, and it will be found that points on a diameter, such as A, B, C, D, E and F will move along the lines shown on the left-hand side to the points A_1, B_1, C_1, D_1, E_1 and F_1.

A hemisphere is the natural shape taken, and is the simplest one to discuss. Actual measurements show that the final wall thickness is that expressed in the percentage figures in Fig. 1. The same principles apply, however, in the blowing of more complicated shapes.

If, for example, blowing were continued inside a mold shaped as in Fig. 2, movement would continue along the same lines until the plastic was stopped by the wall. Friction would prevent any downward motion along the wall, and the entire portion of the spherical end formed by revolving the arc A_1O_1 (Fig. 2) would be formed from the plastic coming from the circular portion of the original sheet whose radius was AO. Obviously, such severe thinning would have occurred that the region A_1O_1 would have no appreciable stiffness even if the original sheet of material were 0.015 to 0.025 in. thick.

The above description refers to material blown and stretched at constant temperature. If a hot sheet is blown in an environment which is at a considerably lower temperature, as in the open air or in a cold mold, the sheet loses heat at a rate which is approximately proportional to the difference in temperature. The heat content is, of course, proportional to the thickness so that the temperature falls very rapidly as the sheet thins down, and its viscosity (resistance to stretching) increases very rapidly (see Fig. 7). This tends to prevent the severe thinning at the lower part of the hemisphere (Fig. 1) and will give an actual thickness for blowing in the open air of about half the original thickness instead of one-third. In the case of Fig. 2, however, severe thinning cannot be prevented and it is only necessary for the cylindrical portion to be long in proportion to its diameter for the end to thin down to useless proportions.

Figures 3a and 3b show how a difference in the direction of approach of the sheet to the mold affects the thickness distribution. In Fig. 3a, the same approximate distribution is obtained as in Fig. 1, when the sheet is blown against a female hemispherical mold. If the sheet is held outside the mold and a male hemispherical mold is pushed up into the sheet, a cap pressed downward clamping the sheet and air used to blow the sheet into tight contact (Fig. 3b), the distribution obtained is quite uniform around most of the hemisphere and tends to be thickest at the top.

A very severe thinning down occurs where the hemisphere joins the flat rim, but the thinning is small in extent. If the hemisphere is trimmed out, leaving a narrow rim, and two such parts are cemented together to form a ball, the resulting article will exhibit considerable strength at all points. The

system shown in Fig. 3b has been found very useful in the forming of Christmas ornaments.

Figure 4 shows the approximate distribution obtained when a flat sheet is blown into contact with the walls of a flat-bottom cylindrical die. The left-hand side shows the hemisphere of plastic just before it contacts the bottom. Thereafter, the plastic moves toward the corner, along the arrow lines, as shown on the right side of Fig. 4. The plastic is stopped as soon as it contacts the mold and is held there by friction. As the edge is approached, the plastic loses thickness rapidly, finally becoming very thin. Such a distribution is not serviceable since the edge will take the most severe abuse. While this condition may be helped by a well-rounded edge, it is not even then satisfactory unless the article requires a very shallow draw. This distribution can be materially improved by using a plunger to effect most of the movement of the plastic and finishing the molding by blowing the plastic into tight contact with the mold.

In Fig. 6, the top of the mold consists of a spring-retained cover surrounding a small plunger. The softened sheet is placed across the female mold, and the cover and plunger descend with the plunger extending a short distance below the cover. Further motion forces down the plunger and causes the sheet to stretch as shown in the left-hand half of the illustration. When the plunger is all the way down, air is admitted to blow the plastic into contact with the mold. The right-hand half of Fig. 6 shows the approximate distribution that results from this action. When the plunger is large, as in Fig. 7, very good distribution is obtained. In this case, the rapidly descending plunger causes a slight pressure in the air trapped below the sheet which tends to prevent movement of the sheet along the face of the plunger and around the curved lower portion of the side. The effect is similar to that shown in Fig. 3b. Final blowing results in a distribution of the plastic such as is shown on the right-hand side of Fig. 7.

Objects may, of course, be blown from other shapes than sheet. Figure 5 shows a piece of tubing, inserted in a mold, ready to be blown to a complicated contour. Just what procedure is necessary may depend upon the plastic but, in general, the mold must be of the split type and must be provided with means for controlling the temperature such as the steam jacket which is shown in this illustration. Rubber corks or other couplings make possible the attachment of a pipe to each end of the tube. In some cases, cup washers work well.

Steam is admitted at one side and blown through the tube until the plastic softens. The outlet is provided with a pressure regulator so that the temperature and pressure can be controlled. The softene plastic will blow outward until it contacts the mold. At this point, air replaces the steam—thus maintaining the pressure while the mold and article are cooled. By using a longer tube and a cup-sealing washer fitting on the inside, the tube may be forced axially inward, helping to fill the large cavities. This procedure results in a better distribution. Under certain conditions, the tube may be preheated in steam, inserted in the mold and blown to size without any change in the mold temperature. Movement might be limited in some cases, but such plastics as polyethylene can be cold blown to size if not too drastic changes in shape are required.

Instead of using internal pressure, the mold may be connected through vents to a vacuum pump, and hot plastic tubes sucked up against the mold. It is necessary to seal the space around the tube at the ends of the mold to prevent the ingress of air. Although conformity to the mold contour is not usually so good as when internal pressure is used, the system has the advantage of permitting long sections of tubing to be heated, part by part, and formed in sections which are later cut apart.

In some cases, it becomes necessary to force the plastic to take shapes which it cannot be made to do by any of the methods previously described. One solution to the problem is to use a rubber diaphragm whose thickness varies in the reverse manner to the stretch that is desired. The thin portions will stretch easily while the thick portions may be made virtually non-stretching under the forces involved.

An application of the diaphragm method is shown in Fig. 8. The figure is in diagram only, all steam jackets and controls being omitted for the sake of simplicity. A plastic disk (*1*) is placed across the top of the female hemispherical mold (*5*), a porous washer (*2*) made from wire screen rests against the plastic. Above this is the variable thickness diaphragm (*3*). The

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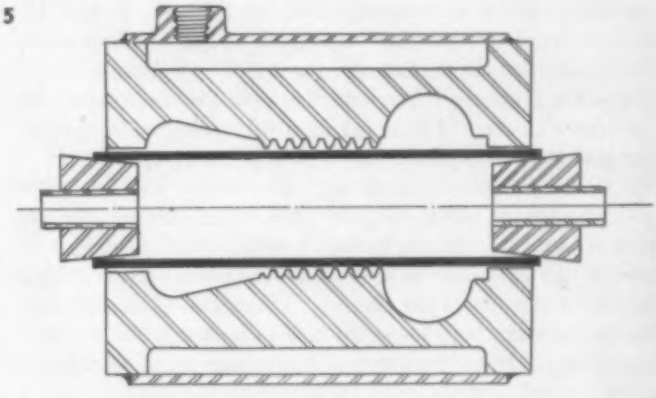

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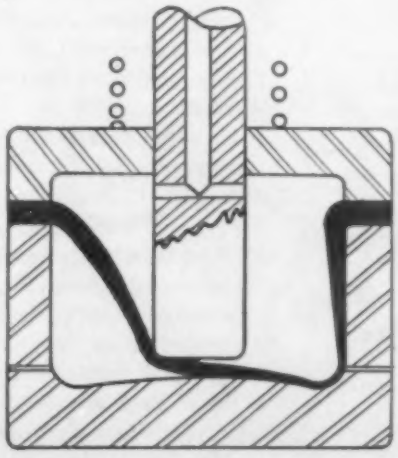

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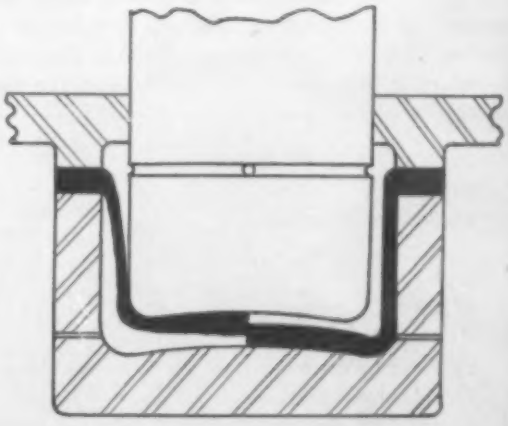
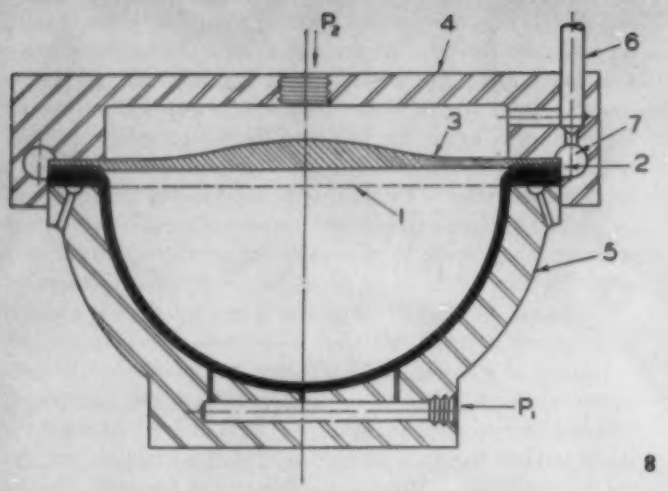


***5**—Here a piece of tubing, inserted in a mold, is ready to be blown to a complicated contour.* ***6** and **7**—These drawings show different methods of improving distribution*



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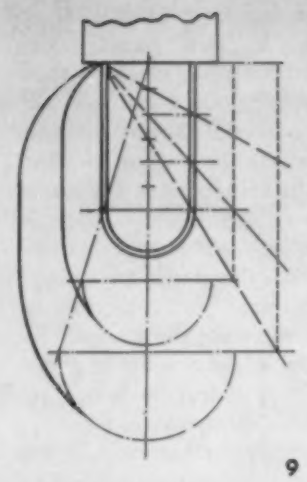

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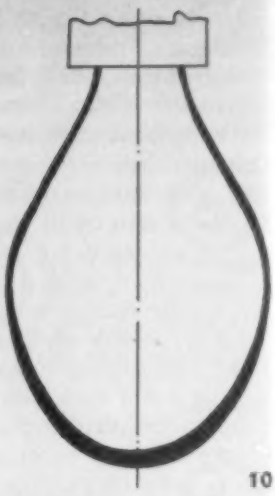

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8—One means of forcing the plastic into a desired shape is to use a rubber diaphragm whose thickness varies in the reverse manner to the stretch that is desired. 9—Superimposed upon this drawing of a tube with a hemispherical end which was taken as a starting shape, are two other contours which will result when the original shape is blown to twice, then three times its original diameter. 10—The effect of gravity on the wall section and shape pictured in Fig. 9

cover (*4*) is pressed downward, sealing against the rubber diaphragm and clamping the sheet. The whole is heated by the application of, say, equal steam pressure to P_1 and P_2. This steam pressure forces the plastic tightly against the diaphragm. Any air between the two escapes through the porous screen washer (*2*) into the annular space (*7*) which remains substantially at atmospheric pressure because of slight leakage between the cover (*4*) and the mold (*5*).

When the plastic has softened uniformly, pressure P_1 is reduced sufficiently below P_2 to cause the diaphragm and plastic to blow into contact with the mold. During all of this motion, the plastic is forced to follow the diaphragm by the frictional forces resulting from the pressure, P_1 and P_2, both of which are substantially above atmospheric pressure. The whole is now cooled and the valve (*6*) opened. This allows the pressure, P_2, to enter between the diaphragm and the blown plastic. The diaphragm will spring back, leaving the plastic against the mold. The whole may then be taken apart and the plastic removed. Obviously, the system is subject to fully automatic operation if the number of parts that are wanted will justify the expense. Hot sheet may be used with a cold mold in which case the cover acts as a shear to cut out the disk of hot plastic. The system is handicapped by the comparatively short life of the diaphragms at common plastic-working temperatures. Moreover, the diaphragm is usually rough and the luster of the plastic may be dulled.

The direct blowing method

As previously stated, there are three major steps in this process: 1) softening the plastic, 2) forming a blank or parison, 3) blowing the parison to final shape. The exact procedure in any case is dependent upon the complicity of the object to be blown.

Group 1—softening the plastic

Chemical:

a) Solvent plasticize.
b) Emulsify plastic.

Heating:

c) Heat by contact.
d) Heat by friction.
e) Heat by controlled hot air or steam blast.
f) Heat by radiation.
g) Heat by electronic methods.

Group 2—forming a blank or parison

a) Dip form in lacquer solution and dry.
b) Dip hot plunger in fine cold powder, thus melting on a coat.
c) Same as above, using outside hot mold.
d) Spray coat a form, then dry and strip.
e) Spray hot blast melted plastic on form, cool, strip.
f) Press parison from hot gob of plastic.
g) Injection mold parison.
h) Extrude sheet, use hot.
i) Extrude tube, use hot.
j) Machine blank, reheat part to be blown.
k) Filter emulsion on mold, dry and heat.
l) Make preform by winding hot sheet.
m) Make preform by dipping cold form in molten plastic.
n) Slush mold parison.

Group 3A—blowing simple shapes

a) Use cold mold and cold air with hot blank.
b) Use cold blank, hot mold and hot air.
c) Use cold mold, cold blank, steam or hot air heat inside blank.
d) Use cold to medium warm mold, cold blank, hot liquid blowing fluid.
e) Use cold mold, cold blank, cycle heat and blow. Then cool mold finished piece.
f) Use vacuum applied to mold to replace internal air pressure in the above.
g) Use rubber bag inside to isolate plastic.
h) Use graduated thickness on rubber bag to control distribution.
i) Blow to intermediate shape to freeze certain areas, then transfer to final blow mold and blow final shape.

Group 3B—blowing complicated shapes

a) First blow large enough ball, then pinch out product.
b) Blow part, pinch part.
c) Pinch and seal in the internal air pressure.
d) Any of above with further complication of punch-forming certain parts.
e) Blow large and cool. Insert complicated shape carefully, reheat and permit plastic to shrink back on form.
f) Metal inserts may be placed in mold and plastic blown

against or around them. This permits undercuts to be blown and the article removed as in regular molding.

g) Metal inlays can be placed in mold and left in place.

Group 4—type of machine

a) Single head, single mold.

b) Single head, multiple mold.

c) Multiple head, multiple mold.

Having stated these methods, it is necessary only to select one from each of the four groups (using 3A or 3B) to outline a blowing process. There are 2646 combinations using Group 3A and 2058 combinations using Group 3B. About two thirds of all of these could result in a useful cycle. The young inventor can spend many an interesting evening writing them up in the form of invention records. This brings up the problem of "How can one select the best cycle for the direct blowing of an article?"

Nearly all commercial operations must start from commercial grades of molding powder, and the process is confined to the thermoplastic type of resin at the present time. The usual method of handling, which involves delivery under pressure, will limit the method of heating to contact heat in which frictional heat may be developed as a secondary matter. The preheating of the powder has led to objectionable complications.

In Group 2, those which have been used commercially with success are: a) the method of forming the parison by dipping the form in a lacquer solution, drying it and stripping it from the form; g) injection molding the parison; i) extruding a tube.

In Group 3A—blowing simple shapes—only "a," which consists of blowing the hot parison in a cold mold with cold air, and "c," which uses a cold or cool mold, a cool blank with steam or hot air used as a blowing and blank-heating means, have been used commercially.

In Group 3B—blowing complicated shapes—the first four methods have been used with success. The type of machine as given in Group 4 will be determined largely by the output wanted from the machine. While this very materially reduces the number of successful applications, it still does not enable one to proceed with assurance in evaluating the direct blowing process.

Discussion of the blowing process

The movement which takes place when a plastic tube having a hemispherical end is blown up in the open air may be of assistance in clarifying the process of blowing such an article as a bottle. In Fig. 9 is shown a tube with a hemispherical end taken as a starting shape. Superimposed upon the picture are two other contours which will result when the original shape is blown to twice its original diameter and then to three times the original diameter.

It can be shown that the expansive forces acting outwardly on the wall are twice those which tend to cause lengthwise stretching and also twice those which tend to blow up the spherical end. The net result is that in the region between the cylindrical portion and the hemispherical portion there is always an anomalous region which tends to have an elliptical shape. A diagram of the movement can be readily laid out by graphical methods as shown in Fig. 9. It can be seen that the tendency is for the original shape to blow up in the form of a sphere.

Now, considering that the plastic is soft during the blowing and that it is acted upon by gravity, it may tend to run down, due more to its own weight than to the air pressure admitted on the inside. The net result is that a pear-shaped bubble is formed in which the wall is heavy at the bottom, thins down at maximum diameter and tends to become very thin at the upper end as shown in Fig. 10. This shape and this distribution are not those which would be desired in the making of bottles. Moreover, it becomes obvious that if the upper portion, which necessarily forms the neck, must be small, and if a heavy-walled bottle is required, such an extruded bubble cannot be allowed to stretch down very much under its own weight without the neck portion losing too much of its thickness. This means that the plastic must be worked in a very stiff condition, and the cycle at the same time be kept quite rapid. While a nice hemispherical bottom can be envisioned, its formation has proved to be a virtual impossibility.

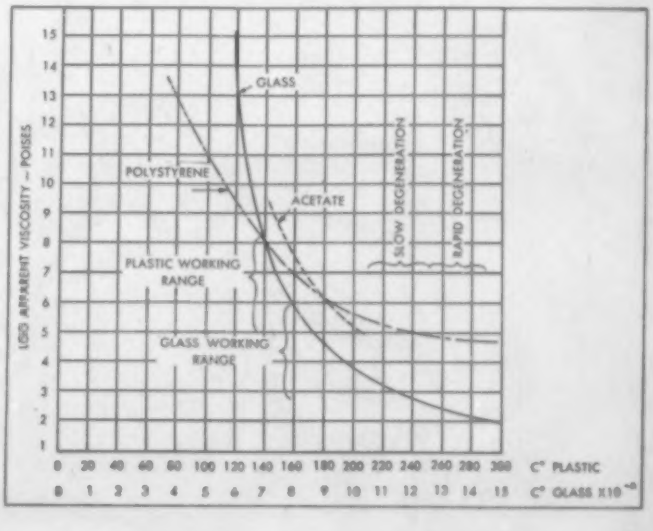
Before continuing with the formation of plastic bottles by the direct blowing method, it may be well to compare methods that are used commercially in forming glass bottles from molten glass.

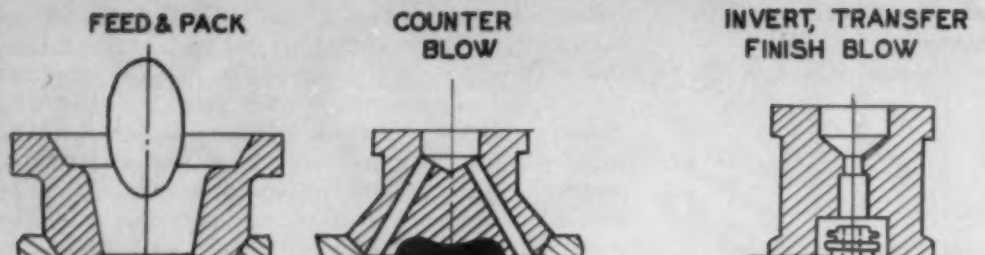
Figure 11 shows the viscosity-temperature curves for two plastics and one composition of lime glass. The typical working range is also given, and it will be seen that the plastic is currently worked at a viscosity range about 500 times that of glass. This means that any movement due to a certain superimposed pressure would be 500 times as rapid in glass as it is in plastic. Were it possible to obtain a plastic having the proper toughness and still able to withstand very high temperatures without decomposition, plastic could be used in the regular glass-working machines except that the temperature range (being about $^1/_{50}$ as high as that of glass in ° C.) would require that the glass molds be water cooled or very carefully cooled with air to prevent sticking.

Unfortunately, in the range of viscosities corresponding to the upper viscosity limits in glass, the plastic begins to decompose and the pressures involved in the plastic machines must be increased to make up for the greater stiffness. Whereas in glass, gravity coupled with air pressures of 50 to 60 p.s.i. is sufficient to accomplish most of the forming operations, plastic machines must be designed to stand pressures in the region of 3000 to 45,000 p.s.i. Naturally, the type of machinery used is very radically modified by these restrictions. However, once the parison is formed, blowing is accomplished with air pressures not greatly differing from those used in blowing glass.

A typical glass-forming cycle is shown in Figs. 12, 13 and

11—*This chart presents the viscosity-temperature curves for two plastics and for one composition of lime glass*





12 13 14

12, 13 *and* **14**—*A typical glass-forming cycle. In Fig. 12 a gob of molten glass is dropped into a parison mold. Next (Fig. 13) a parsion is formed having the shape and approximate distribution of the solid black section. In Fig. 14 the parsion has been inverted and transferred for the final blowing*

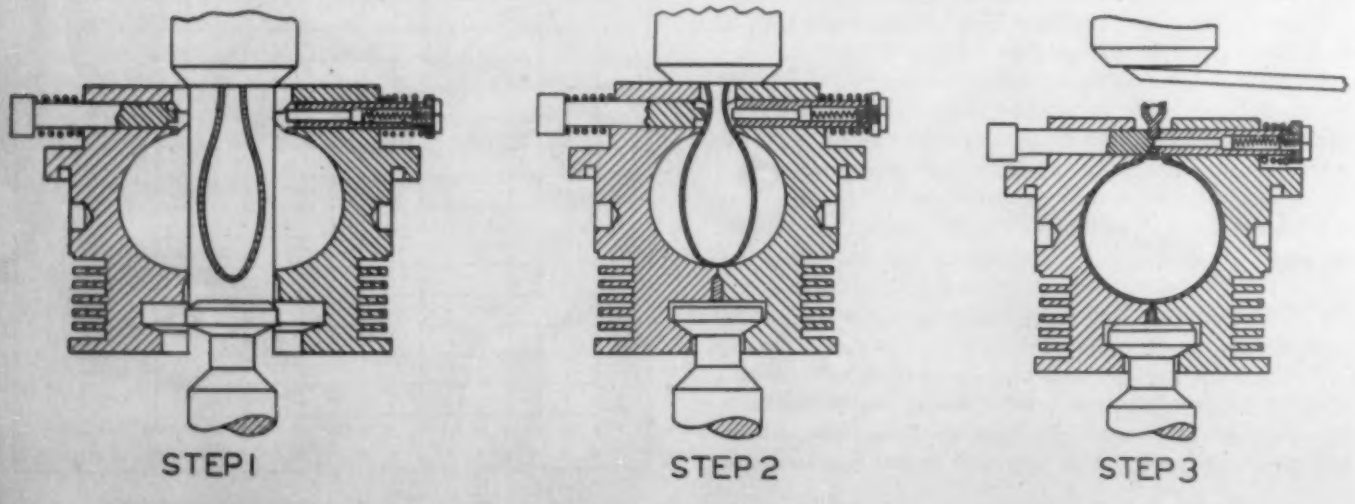
14. In Fig. 13 a gob of molten glass, perhaps the size of an egg, is dropped into a parison mold which has the shape of the upper end of the neck of the bottle to be formed, but otherwise varying quite markedly in its shape. In the bottom of the mold is a set of parts which form a slight cavity extending into what will be the neck of the bottle. The gob of hot glass is guided into the parison mold by means of a funnel, and due to its velocity and its weight it pushes down into the mold, more or less sealing itself against the wall.

Almost at the same instant of time, a blow head is swung over the upward end of the inverted parison mold and air pressure is applied to force the glass tightly into the neck cavity and into the threads which will hold the bottle cap.

During this time, the glass in the immediate vicinity of the neck solidifies very rapidly. The events depicted in Fig. 13 now take place in rapid sequence. The little plunger in Fig. 13 drops out of contact with the glass and air pressure is supplied around the periphery of the plunger. The blow head used to pack the charge fits over the top of the parison mold (still inverted) and forms a mold for the bottom of the parison, which is still bottom side up. The little section of glass which is immediately in contact with the plunger picks up heat very rapidly from the body of the molten glass immediately adjacent to it and becomes soft, so that the air pressure admitted around the plunger immediately starts a bubble rising up through the center of the packed gob, at the same time pushing the molten glass ahead of it until further motion is stopped by complete contact with the mold surfaces. In this condition, the parison has the shape and approximate distribution as shown in solid black in Fig. 13.

The parison is now inverted and while still held in the neck ring is transferred to the final blowing position shown in Fig. 14. The blow mold halves close around the neck just below a bead. The neck ring opens so that the parison is left hang-

15—*Among the articles blow molded on a modified injection molding machine are Christmas tree balls. In Step 1, a small extruded tube about 7/16 in. in diameter and slightly longer than the diameter of the ball hangs suspended between the open halves of the mold. When the mold halves close about this extrusion, as in Step 2, they pinch the bottom. The blowing continues until the plastic takes the form of the mold. When the plastic reaches this shape it is thin and freezes very rapidly in contact with the cold mold. In Step 3 the halves of the mold are ready to open*



ing inside the blow mold as shown by the dotted lines. A final blow head now descends around the top of the parison (now right side up) and air pressure is applied.

Owing to the sealing action of the bead which suspends the parison, the air pressure is greater inside the bottle than it is outside, and the parison is blown in tight contact against the mold. Each time the glass touches the iron of the mold, a hard skin forms on its surface and it is necessary to provide time for more heat to soak outward from the main body of molten glass to melt this skin.

In plastic, the heat transfer from the inside of the plastic mass to a frozen outer skin is so slow that it cannot be utilized to any great extent. The closest approach to the glass-working cycle in the plastic art is the system whereby the parison is injection molded and is then transferred to a blow mold where it is blown to its final shape.

The great handicap suffered by the plastic in this process is that the plunger used to form the inside of the parison must of necessity be withdrawn through the neck of the bottle and it is, therefore, impossible to form any shape of parison such as shown in Fig. 13. Only wide-mouth bottles of small depth have been successfully made by the injection-molding process.

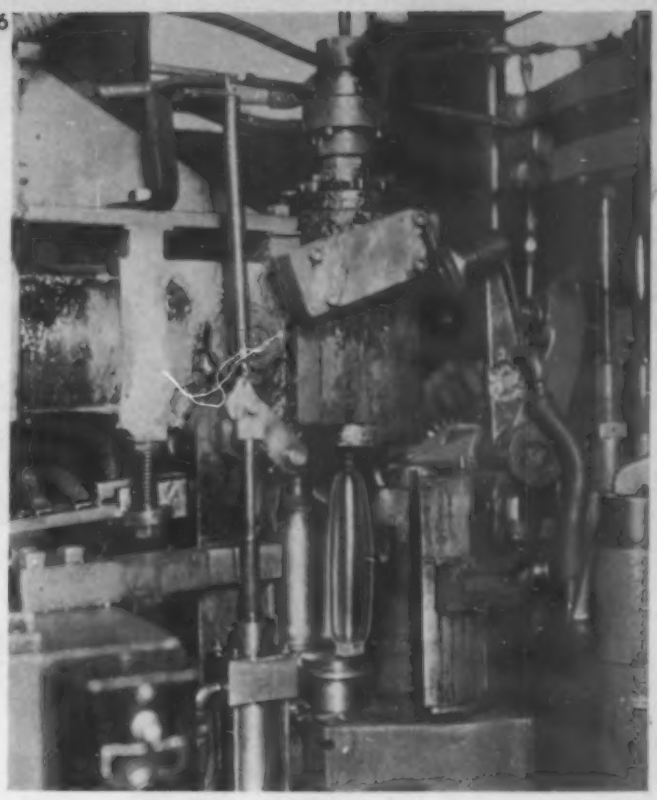
The system used by Plax consists of a modified injection-molding machine which is provided with a measuring device to measure out the charges for each individual shot. Cold molding powder is forced through a heating chamber into a crosshead which is provided with an air tube through the center and through suitable nozzles so that a tube will be formed by the extrusion. When the tube is small in diameter and heavy walled, certain mechanisms in the crosshead permit the closing of the bottom so that the tube issues as a closed end tube somewhat similar to that shown in Fig. 9, but usually not so well distributed near the closed end. The center nozzle of the head is adjustable in such a manner that the wall thickness of the tube can be varied at will over certain limits, and the orifice which forms the outer diameter is a replaceable part which enables the extrusion of a tube of any diameter.

Changing the inner nozzle height permits the changing of the wall thickness, and thereby the changing of the length of the extruded piece which is made from each individual charge of molding powder. As soon as an extrusion is completed, a blow mold rotates into position and closes around the extrusion. Air pressure is then applied through the center of the air tube to blow the hot plastic in tight contact with the mold. Immediately after this, the head is raised enough to permit a slitting knife to pass across the orifice and thus sever the extrusion from the blow head. The mold is then advanced one stage and the cycle is repeated.

The machine is arranged to permit the descent of a blow head on the top of the mold immediately the mold leaves the position of extrusion, and this blow head follows around with the table. Air pressure is thereby maintained on the inside of the bottle until it reaches the vicinity of the third position, where the blow head is raised just before the mold reaches the take-out position. At the take-out position, an arm with a small plunger at the end descends into the neck of the bottle, thus holding it in place while the mold halves open. As soon as the bottle is fully released from the mold, it is ejected by an air jet.

The procedure from this point on depends somewhat on the character of the article being manufactured, but in most cases the article slides down a chute onto a chain belt where it is carried through a series of water sprays which remove the remaining heat from the plastic, thus stiffening it enough to be dumped into tote boxes without danger of losing the desired shape. (*Please turn to page 198*)

16



16—*For the formation of a large bottle, the bubble of plastic is extruded and blown in the atmosphere to a size and shape such as shown in this picture. The two halves of the split mold, shown here in the open position, then close tightly about this hollow gob.* **17**—*The finished blown plastic bottle after the blowing cycle has been completed. The mold in this case is designed to form a standard threaded neck on the bottle*

17

Plaskon Closures

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THERE are three major features which distinguish Plaskon Molded Color for closures: utility, economy, and attractiveness. Plaskon molding materials are plastics that are especially resistant to the chemical and physical action of a wide variety of products that must be packaged. Plaskon is completely impervious to the effects of alcohol, acetone, or other common organic solvents. It is not affected by oils, fats or greases. Because it is odorless, tasteless and inert, it has no effect upon any products with which it comes into contact. Plaskon can be molded in large quantities at very economical prices. Distinctive designs and shapes can be secured to give new individuality to packages. Plaskon is available in a wide range of beautiful, permanent colors that improve the appearance of any container, catch the eye and help make sales. We can give you helpful assistance in suggesting designs, qualified Plaskon molders, and technical advice so that you can efficiently adapt Plaskon Molded Color to your manufacturing and sales programs.

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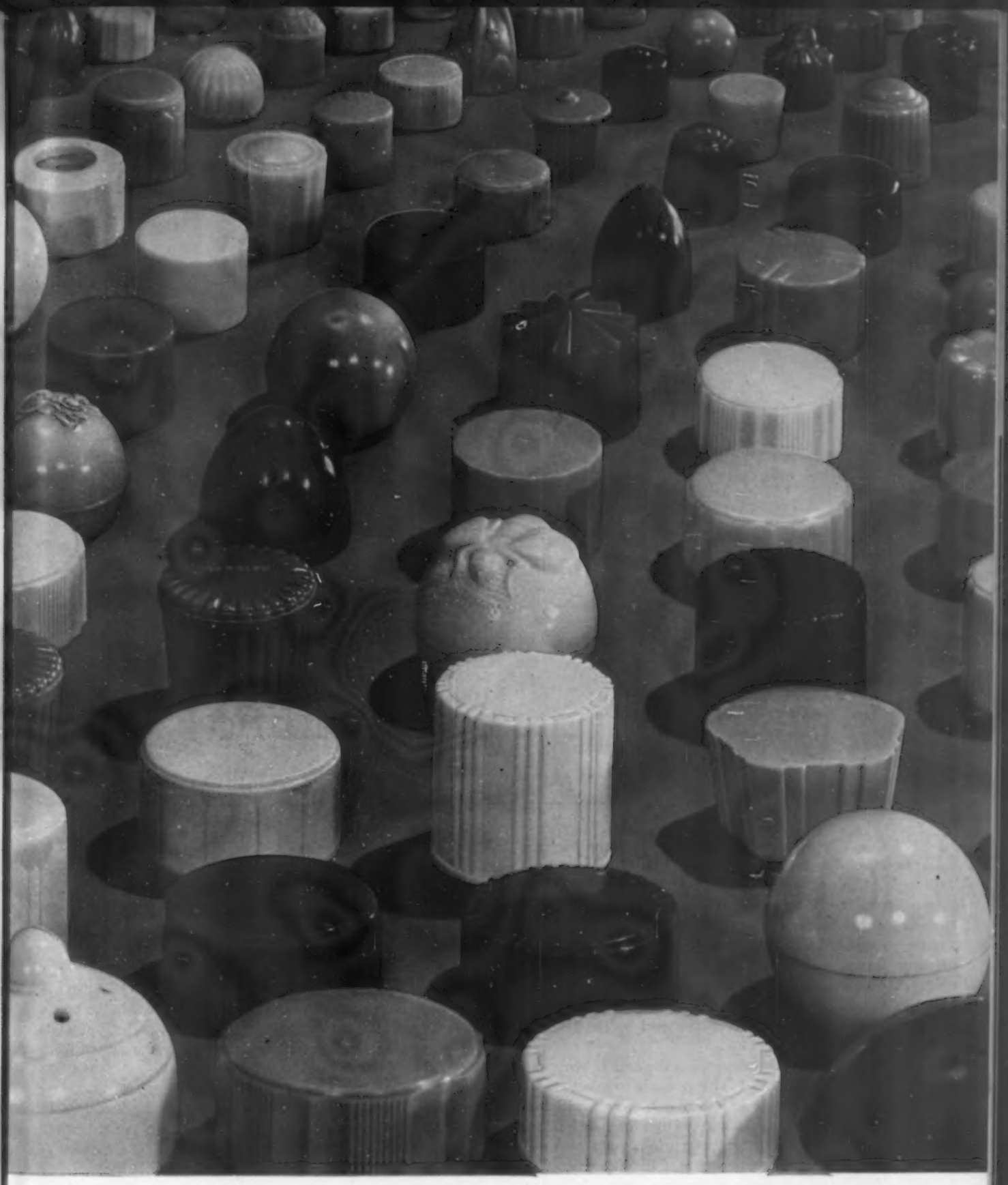

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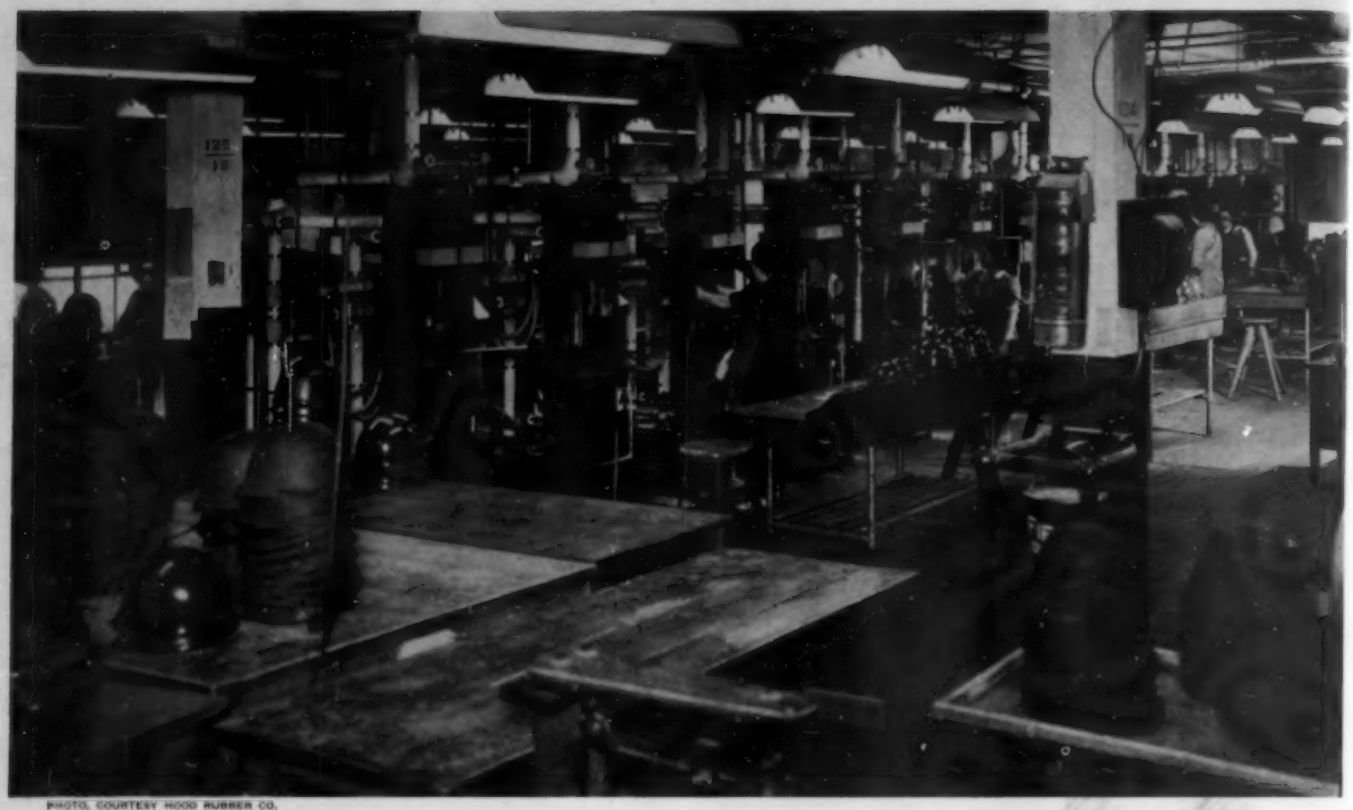


PHOTO, COURTESY HOOD RUBBER CO.

1—*The helmet liners shown in the foreground of this plant picture were produced by the low-pressure molding method in which an inflated rubber bag formed the male portion of the die and metal, the female portion*

Let's define impression molding

by GEORGE W. DeBELL*

THERE has been considerable discussion in the industry concerning the use of a term which will include the various so-called low-pressure molding methods. Up to the present, these methods have been known by several names, such as low-pressure molding, bag molding, contact-pressure molding, contact laminating, low-pressure laminating, no-pressure laminating. Because of this confusion of terminology, the expression "impression molding" was recently proposed to encompass the entire field without conflicting with the variations in fabrication procedure used by the different companies in the industry.

It appears that in all this discussion the cart is being put before the horse. An attempt is being made to select an all-encompassing name prior to an agreement on a definition of the portion of the industry to be covered by the name. Let us first determine what salient characteristic is common to all the methods employed in this branch of the industry; then we will be in a better position to define its scope and select an appropriate term.

Within this branch of the industry there also seems to be some confusion in the use of the word "molding" and the word "laminating." For many years "molding" has been associated with the fabrication of plastic articles from bulk material, and "laminating" with the fabrication of plastic articles from multiple plies of sheet material. On the other hand, manufacturers fabricating by any of the various "impression" molding methods have indiscriminately used the words "molding" or "laminating" to describe the process they are using, even though in practically every instance the products are manufactured using sheet material. For the sake of uniformity in nomenclature, it would be preferable if the world "molding" were used only when the products were made from bulk material, and the word "laminating" only when the products were made from sheet material. When the word "laminating" is mentioned, many people think in terms of flat sheets, but this is an erroneous conception, as laminated products may be either flat or shaped. By the same token, molded products can be either flat or curved.

Figure 2 illustrates a typical setup for low-pressure laminating or molding. While a curved piece is being produced in this instance, the same design features are present when flat parts are manufactured by this process. The contour of the outer surface of the product shown in Fig. 2 is controlled by the shape of the rigid die, but the contour of the inside of the product is merely defined by the rubber bag. Under such conditions rigid dimensional control of the product is obtained on one surface alone. For instance, accurately located lugs, or ribs, can be incorporated in the die, but they cannot be incorporated in the rubber bag. Products having ribs and like details on the rubber bag side have been manufactured, but only in cases where extremely loose tolerances as to dimension and location were permissible.

Figure 3 illustrates bag laminating, or molding. It will be

* Consulting engineer.

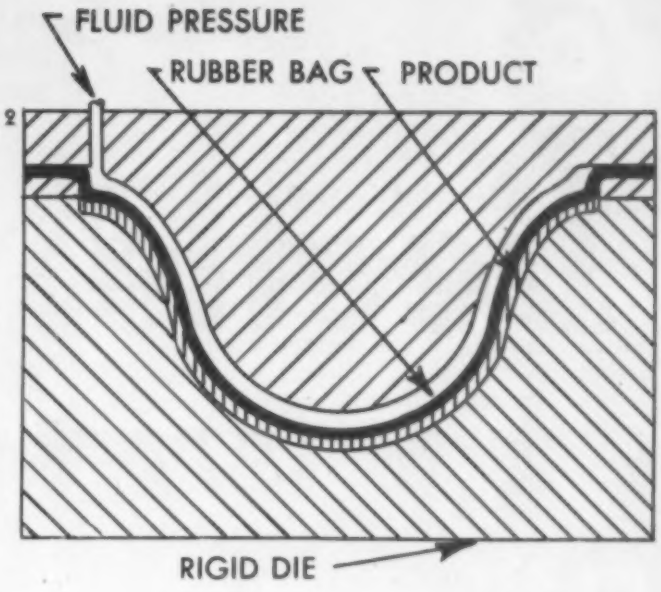
noticed that the one essential difference between this process and low-pressure laminating, or molding, is in the method by which heat and pressure are supplied. In bag molding the heat is usually supplied through the pressure fluid, although the die may be independently heated. Here, again, only one surface of the product is controlled by a rigid die and, therefore, the same limitations on dimensional tolerances apply as in low-pressure laminating or molding.

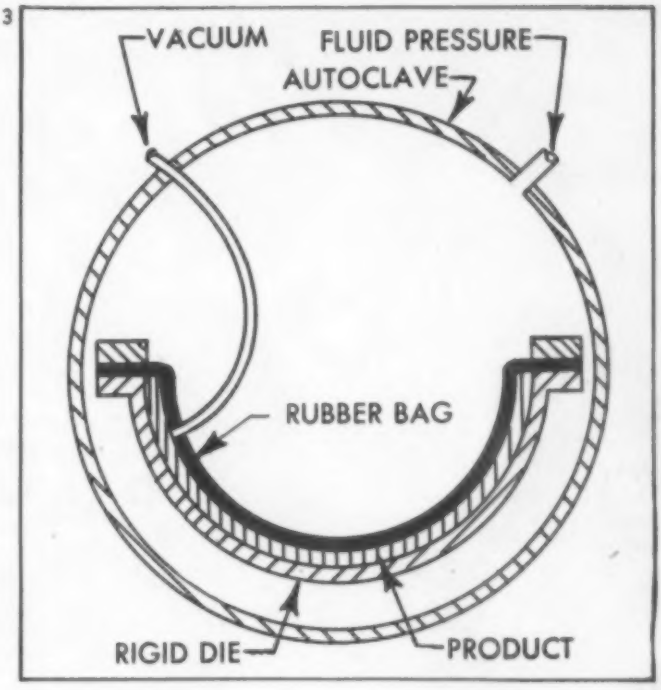
Figure 4 shows the usual method employed in contact-pressure laminating, or molding. Again, only one surface of the product conforms to the contour of a rigid die, and the same dimensional limitations are again apparent.

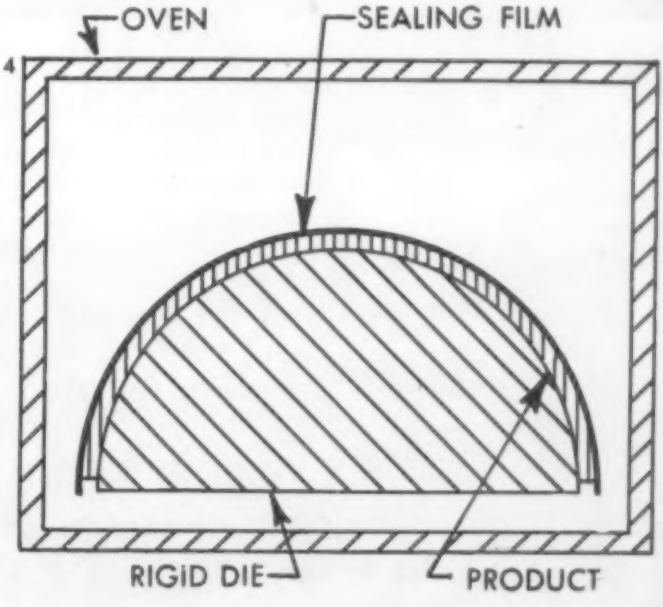
In so-called high-pressure laminating, or molding, as illustrated in Fig. 5, the product is molded between two rigid dies, making possible a close control on all dimensional tolerances, both inside and out. If highly polished dies are used, a lustrous surface may be produced on both the inside and outside of the product—a result not possible when the various forms of "impression" molding are used. Then only the surface which is formed against the rigid die can be accurately controlled as to surface texture.

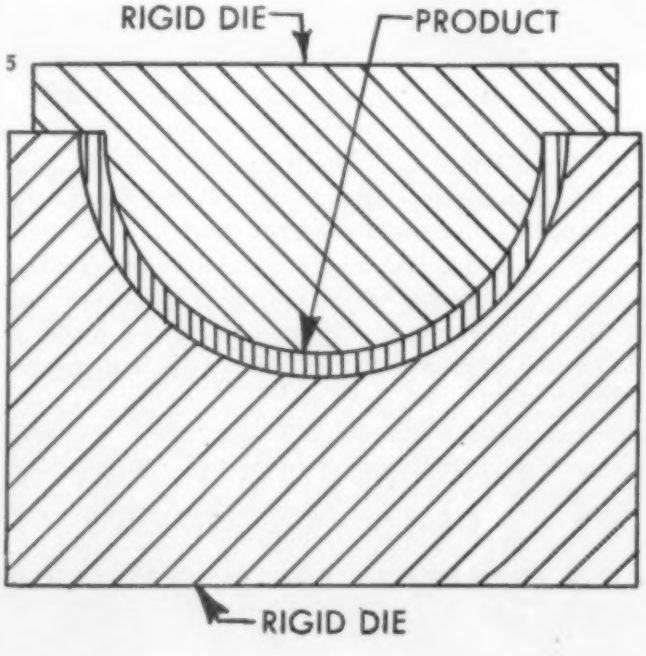
Any attempt to distinguish between the above-mentioned processes on a basis of molding pressure is misleading since the pressure range that is employed is not an inherent characteristic of the process. Not only do the pressure ranges used in each of the processes overlap each other, but the pressures themselves depend more on the type of resin and filler material than on differences in manufacturing methods.

The higher pressures normally used when molding between rigid dies are due to the necessity of smoothing out variations in the molding material thickness rather than to the need of higher pressures to produce the proper cure. If a so-called low-pressure molding material were carefully calendered as to thickness, and then molded be- (*Please turn to page 190*)









2—This drawing illustrates the basic principles of low-pressure laminating or molding. 3—A typical setup for bag laminating or molding. 4—In the usual method employed in contact-pressure laminating or molding, only one surface of the product conforms to the contour of a rigid die. 5—In high-pressure laminating or molding, the product is always molded between two rigid dies

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LIFE ON THE PLASTICS NEWSFRONT

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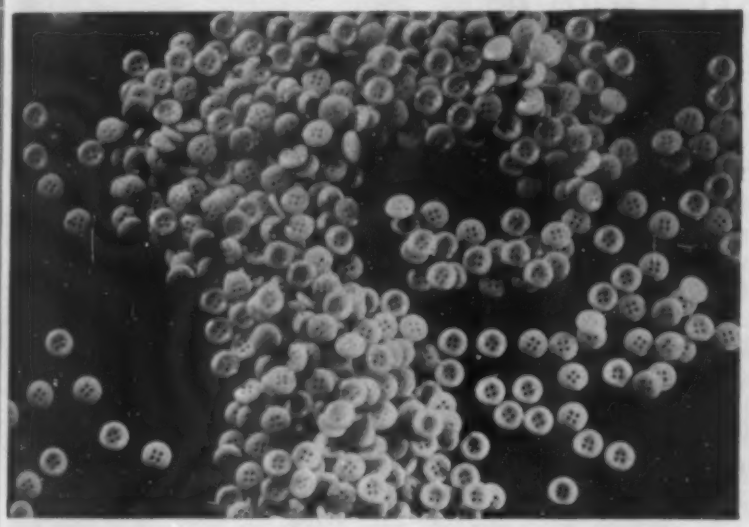
(*Above*) **HOUSINGS FOR CLOCKS,** radios, electric razors, timers, and a variety of other items molded of BEETLE have color appeal, a pleasant feel, and resistance to wear and abrasion that means durability.



(*Above*) **BUTTONS** in white, pearl, ivory, or colors to match materials, can be molded of BEETLE with complete assurance of uniform strength, size, and shape, unvarying color, luster and brilliance.

(*Below*) **IN ELECTRICAL APPLICATIONS** such as these switches made by Micro Switch Corporation to control airplane mechanisms, BEETLE's dimensional stability, dielectric properties, and light weight help assure reliable performance under extreme service conditions. Practical use is also made of BEETLE's color in the housing covers to identify contact arrangement and type of switch.

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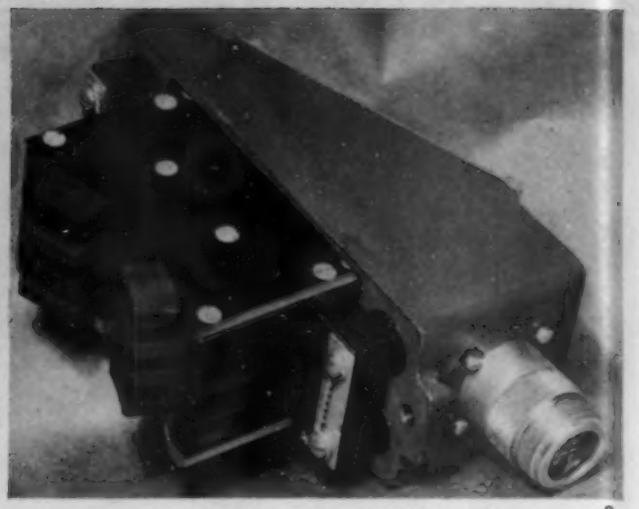


2

1—The molded brush holder is mounted on the propeller shaft behind the propeller. 2—This brush holder, built up of machined laminated phenolic parts, was used in planes prior to the development of the phenolic brush holder

The propeller brush holder

by MAURICE E. CUSHMAN*

THE molded propeller brush holder is an example of the wide range of design possibilities presented by molded plastics for the solution of otherwise difficult problems. This brush holder is used, with its related parts, to transmit electric power from the aircraft power supply to the pitch change mechanism on the rotating propeller. This pitch change mechanism utilizes a reversible direct-current motor, coupled to the blades through a speed reducer, to control the propeller blade angle or pitch. The basic function of an aircraft propeller is, of course, to efficiently convert engine torque to useful thrust. However, control of the propeller-blade angle permits the modern controllable pitch propeller to perform several other functions essential to the safety and efficiency of modern aircraft.

Of these operations, the one of first importance is the constant speed control required of the propeller in order to provide optimum power plant efficiency. Associated with this requirement is the desirability of governing and synchronizing speeds of the engines on a multi-engined airplane within approximately one r.p.m. Also, ability to feather is a necessity for propellers used on multi-engined airplanes in order to avoid windmilling and to reduce drag when one engine becomes inoperative for any reason. The ability to reverse the blade angle to negative values in order to produce a negative or braking thrust has also proved desirable, particularly on multi-engined planes when it is used as a landing brake.

In this propeller, constant engine speed under varying flight conditions is accomplished by automatically adjusting the angles of the blades by energizing the pitch changemotor as dictated by an engine-driven governor mounted on a pad on the engine nose. Manual selector switches are provided to control the feathering and reversing operations. The single action of throwing one of these switches discontinues the normal automatic pitch control and feathers or reverses the propeller without further attention. A voltage booster is used for these operations to provide a rate of pitch change of approximately four times the normal rate.

A synchronizing system, applicable to multi-engined installations, can be provided which automatically governs and maintains all engines at the same speed within approximately one r.p.m. This synchronizing system is based on a comparison of the selected mechanical speed of an independent direct-current master motor and the electrical "speed" induced by the frequencies of an alternating current. These frequencies, generated by alternators driven from the various engines, are proportional to the engine speeds.

In addition to these controls, a three-way selector switch provides automatic constant speed in one of its positions and fixed pitch in the off position. It has two momentary positions which give increase or decrease of pitch operation at will.

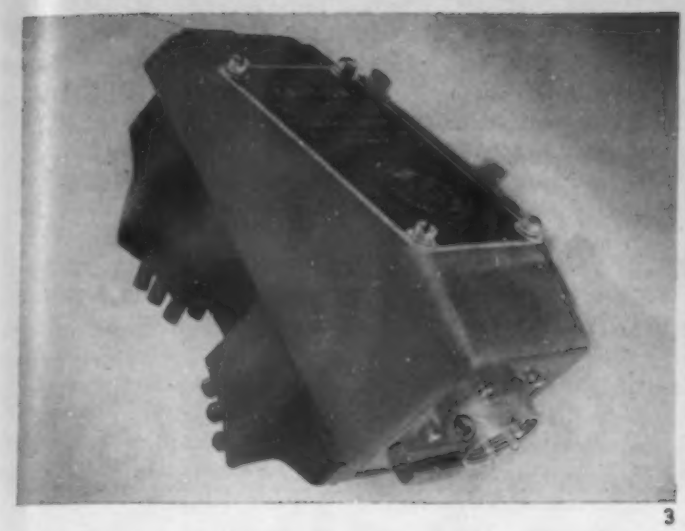
During automatic constant speed operation, which is the normal endurance operating condition for the propeller, the brush assembly must transmit intermittent power impulses from the governor ranging up to 60 amperes at 24 volts d. c. These intermittent power impulses are of a fraction of a second duration at a frequency of up to one energization per second. For the feathering and reversing operations, the brush assembly is required to handle boosted voltages as high as 100 volts d. c. for periods of up to 10 seconds.

In order to provide the multiple pitch controls required, six slip rings are provided on current propeller models. It is necessary, of course, for an equal number of circuits to be installed in the brush holder. These circuits include one for each of the following control operations:

1. Normal increase pitch
2. Normal decrease pitch
3. Feathering
4. Reversing
5. Common return
6. Radio interference elimination bonding

In some earlier models of the Curtiss propeller, which did

* Project engineer, Curtiss-Wright Corp., Propeller Division.



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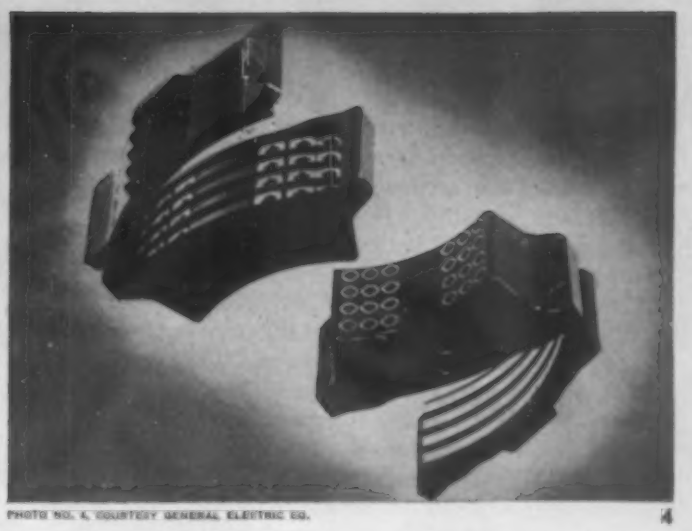


PHOTO NO. 4, COURTESY GENERAL ELECTRIC CO.

4

3—A four-row brush assembly ready for installation in a plane. This housing holds the molded parts that are shown in Fig. 4. 4—Two views of the molded phenolic parts that go to make up the four-row brush assembly

not include a separate reverse pitch circuit, the bonding circuit was completed by brushes housed in a separate holder so that only four circuits were needed in the main brush holder. However, the proximity of the several opposite electrical potential circuits in the holder presents a major problem in insulation, particularly during boosted voltage operation. This problem becomes important primarily because of the presence of carbon dust from the brushes which may collect on the face of the holder and produce a conducting path between opposite potential brushes. Because of the location of the brush assembly, which is mounted on the engine nose at the rear of the propeller (Fig. 1) the holder may also become wet as the result of oil leaking from the engine nose. The carbon dust will adhere to such an oil film and form an excellent path for a short circuit arc.

The location of the brush assembly on the engine nose also subjects the brush holder to high vibratory accelerations acting, for the most part, in a plane perpendicular to the propeller axis.

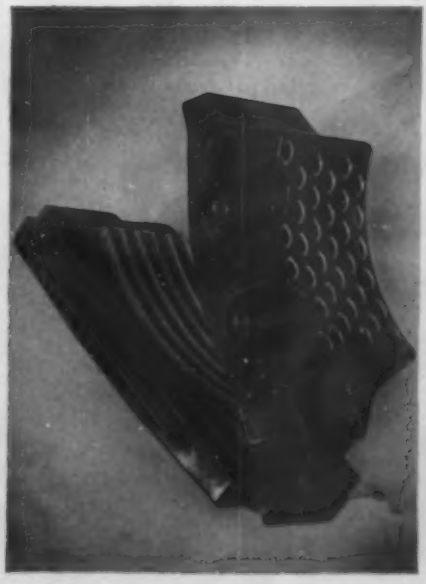
In addition to these design considerations, it should be noted that space and weight are at a premium in this application. Space requirements are particularly critical since any increase in width of the holder would cause the whole propeller to be moved forward. Also, in order to permit proper maintenance of these parts, it is essential that the design be so planned that they can be quickly and easily removed for inspection.

Prior to the development of the molded brush holders, a built-up holder of the type shown in Fig. 2 was in use. This holder consisted of several machined laminated phenolic plates slotted so as to provide brush guide slots directly in the phenolic and carrying two relatively large brushes per slip ring. Service experience with this holder indicated a need for a redesign of both the brushes and their holder. One common difficulty arose from the fact that the brushes ran at a high enough temperature to cause the surrounding laminated phenolic in the brush guide slots to swell and blister to an extent sufficient to jam the brushes in their slots, thus preventing the motion necessary for the brush to follow the ring. Another major difficulty was that the normal clearance re-

5—All parts of the present six-row brush assembly are molded, thereby eliminating the cast aluminum alloy cap. 6 and 7—These two pictures show the back and front of the molded parts that comprise the six-row brush holder

5

6



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quired between the brush and its guide slot was such that, with the brush shape that was in use, the brush could at times chatter on the ring violently enough to cause complete disintegration of the brush within a matter of minutes. However, this clearance was necessary to provide for manufacturing tolerances and normal dimensional changes with temperature and humidity. It was realized that in order to minimize these difficulties it would be necessary to provide close fitting metallic guides for the brushes.

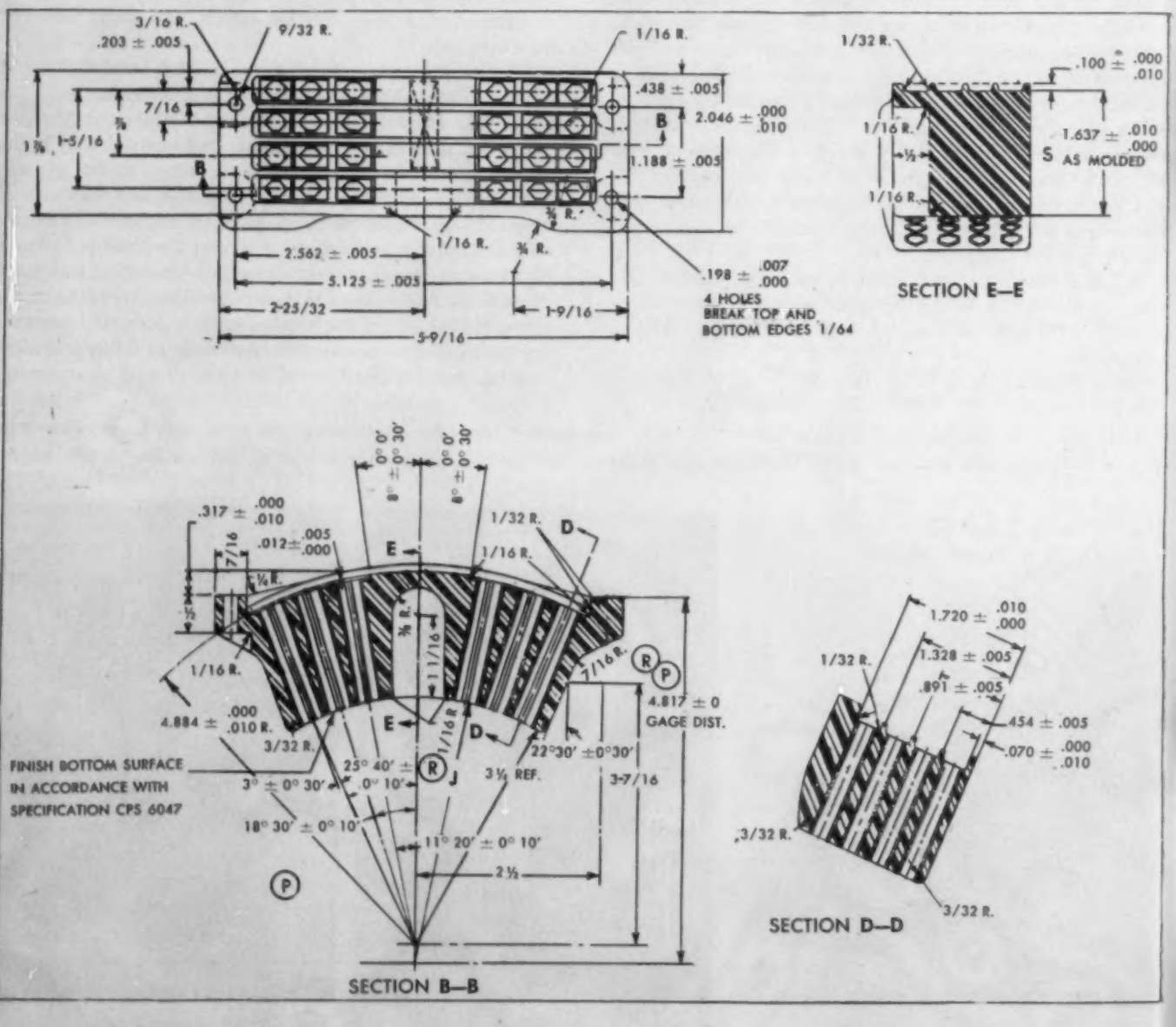
The problem of brush "bounce" under vibration and the resultant arcing between brushes and slip rings was found to be solved to the best advantage by the use of a multiplicity of small brushes rather than two larger brushes. The optimum number of brushes per ring was found to be six. Thus the problem resolved itself into one of how best to provide six metallic brush guide tubes per slip ring. In order to minimize the possibility of brush chatter due to the small clearance required between the brushes and the metallic guide tubes, a generally diamond-shaped cross-section was chosen for the brushes. Friction between brush and slip ring then holds the brush in one point of the diamond—centering it and minimizing chattering.

With the functional requirements of the new brush holder thus established, it became obvious that molding was the best method of mounting the brush guide tubes. Although a minimum number of separate pieces is desirable in the brush assembly, particularly under the vibratory loads involved, the necessity for ease of inspection and replacement of brushes dictated the two-piece molded design. Thus the assembly evolved into two molded parts, a block to support and insulate the brush guide tubes, and a cover whose function it is to retain the brushes in the tubes and distribute the electric current to the brushes.

To permit testing of this design prior to the fabrication of molds, several sets of block and cover assemblies were machined from molded macerated phenolic blocks. The guide tubes were simply pressed into broached holes in the machined blocks. These parts underwent extensive laboratory and flight testing which proved the basic design to be entirely satisfactory. The next step was to develop a design satisfactory for molding and a molding technique which would permit the large-scale production of these parts.

The Boonton Molding Company had been consulted early in the design stage and con- (*Please turn to page 192*)

8—*As this drawing of the molded phenolic block indicates, tolerances are close but practical*



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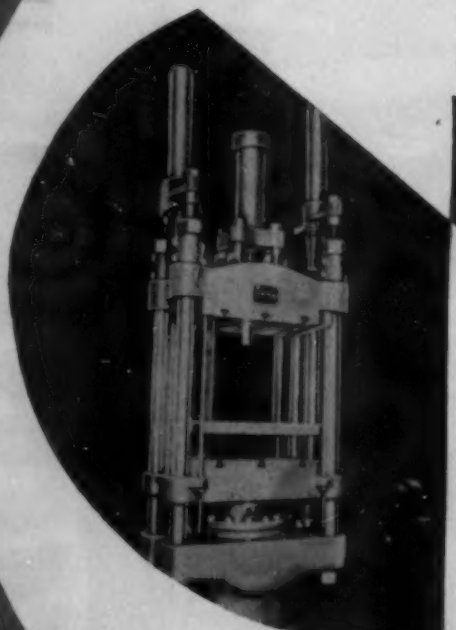

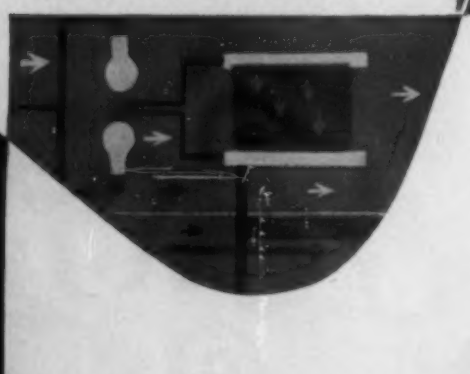

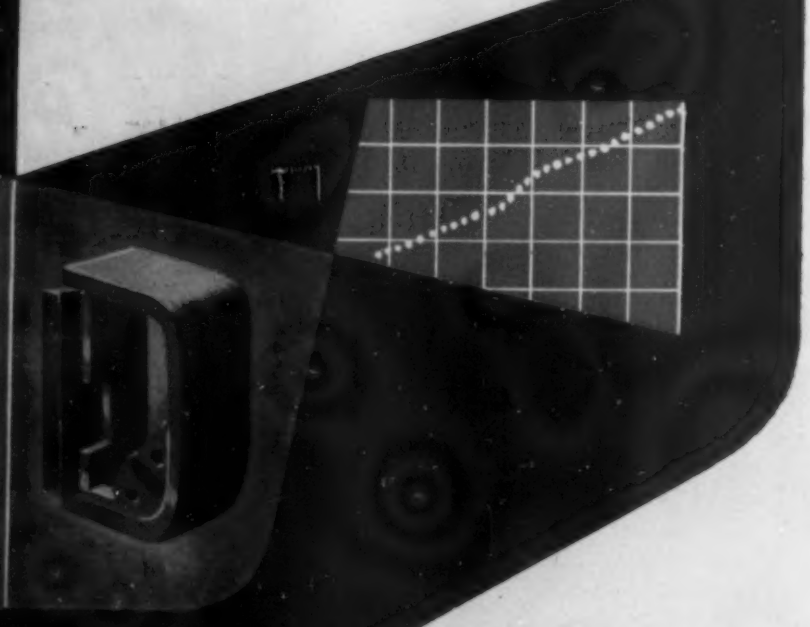

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Impact testing of plastics, Part II—Factors which influence the energy absorbed by the specimen*

by DAVID TELFAIR and H. K. NASON**

IN an earlier paper (1)[1] the authors discussed certain disadvantages of the standard pendulum-type Izod and Charpy impact test methods. In particular, it was shown that the energy measured by these tests often obscures the true impact resistance of a material by including the energy absorbed in tearing apart and throwing the broken ends. Only that portion of the energy used in fracturing the specimen is of practical significance. Several authors have discussed revised impact machines and test methods (1–6) which are designed to measure only the energy to fracture. Such methods and machines are necessary prerequisites to any attempt to correlate impact strength with other properties, or to interpret impact test results in terms of more fundamental properties of a material. As a number of authors have pointed out, however (7–13), there exist several complicating factors, the most important of which are:

(1) Dimensions of the test specimen;
(2) the notch;
(3) Rate of stressing;
(4) Temperature.

It will be the purpose of this paper to discuss these factors as they apply to the impact testing of plastics. It is hoped that such a discussion will help to clarify many of the problems involved, and will throw light on the possibilities of the impact test as a means of revealing the physical properties of plastic materials.

Fundamental considerations

Impact strength, in its usual sense, might be defined as the energy absorbed in the process of deforming a standard specimen to the point of rupture. This energy must be supplied by externally loading the specimen and thereby building up internal stresses which eventually result in failure at some localized point. The energy absorbed in the internal stressing is equal to the external work done by the applied load.

$$W = \int_0^S p\,ds \qquad \text{(Equation 1)}$$

where W is the external work done, p is the applied, load, s is the distance through which the load p has moved and S is the value of this distance at the point of failure. If the deformation follows Hooke's law, i.e., if $p = ks$, then Equation 1 integrates to:

$$W = \frac{PS}{2} \qquad \text{(Equation 2)}$$

where P is the value of p at the point of failure. In the general case, where Hooke's law is not obeyed, the integral (Equation 1) may be evaluated by measuring the area under the load-deformation curve with a planimeter.

Thus it is seen that both force and the distance through which the force moves are involved in determining impact strength. Alternatively, this may be stated by saying that both the strength and the ability of a material to deform under load are involved.

It is known from experiment that, under proper stress conditions, extremely brittle materials, such as marble or cast iron, will exhibit a surprisingly high degree of ductile deformation. On the other hand, even the most ductile of metals can be made to fail in a brittle fashion when they are subjected to certain other conditions of stress. To a fair degree of approximation, the stress conditions which determine whether a failure will be ductile or brittle may be described in terms of $\sigma_{max.}$ and $\tau_{max.}$, the maximum tensile stress and maximum shearing stress, respectively. In all materials, plastic or ductile deformation takes place under the action of shearing stress, after the latter has reached a certain critical value. Likewise, a material fractures only when the tensile stress reaches a critical value. If $\sigma_{max.}$ reaches its critical value before $\tau_{max.}$ reaches the value at which yielding takes place, then brittle fracture occurs.[2] Otherwise, the material will deform ductilely until, under the action of strain hardening, the critical values of tensile and shearing stress are changed so as to result in failure.

The effect of a notch in producing brittle failure may be best described in terms of the above approach. Around the base of the notch there exists a state of stress corresponding to a high value of $\sigma_{max.}$ and a low value of $\tau_{max.}$ The possibility of ductile deformation is thereby greatly lowered, and brittle failure or diminished ductility results.

Different types of impact specimens, e.g., tension, torsion or flexed beams, will have different ratios of maximum shearing to maximum tensile stress, and consequently one specimen may give a ductile failure and show a high impact strength, whereas another, of the same material, will result in a brittle failure and a low impact strength. (*Please turn to next page*)

* Presented at the 1944 Annual Meeting of the American Society for Testing Materials in New York and published here through the courtesy of that Society.

** Research Department, Monsanto Chemical Company.

[1] Numbers in parentheses refer to the bibliography at the end of this paper.

[2] This interpretation has been verified experimentally for transparent Bakelites BT-61-893 and BT-46-001 by photoelastic stress analysis. See M. M. Frocht, J. Applied Mech. J, No. 3, A-99 (1936).

If we are concerned with materials which exhibit a brittle failure under conditions of tensile, flexural or even torsional loading, such as many plastics, then the impact strength is not complicated by the question of ductility. In such cases we may use Equation 2 for describing the energy stored in the test specimen. The classical theory of elasticity allows us to express the maximum load (P) and the maximum deflection, or distance through which the load moves (S), in terms of the dimensions of the specimen, the critical stress or the stress at which failure takes place, and the moduli of elasticity of the material.[3] Table I gives expressions for the energy derived in this way for several possible test specimens. Comparison of the equation for the simple unnotched beam with experiment will be made later in this paper.

It should be clearly understood that these equations can be expected to be good approximations only a) for unnotched specimens, b) when values of maximum stresses and moduli corresponding to the speed and temperatures of testing are used, and c) for cases of brittle fracture, or where the load-deformation curve is approximately a straight line.

The effect of a notch will always be such as to complicate the distribution of stress in the specimen in such a way that a mathematical analysis becomes very difficult or impractical. If the material is a typically brittle one, the impact strength is lowered because of the stress-concentrating action of the notch. The chances are, however, that this lowering of impact strength will not be so pronounced as it is for a typically ductile material, if the notch sufficiently inhibits plastic deformation to result in brittle failure.

Rate of stressing

Perhaps the most outstanding difference between plastics and metals is the greater dependence of the former upon the time scale. In general it is not possible to consider strain of plastics as a function of stress alone, as in the case of metals at room temperature. For plastics, strain becomes a function of stress and of *time*. They must be considered as viscoelastic rather than as elastic materials. One manifestation of this time-dependent character of plastics is their relatively large creep under steady load (14). Another, their high capacity for damping out mechanical vibrations (15, 16).

There is a common concept to the effect that as the speed of loading increases the impact strength of a material decreases. Actually, the reverse is more nearly consistent with experiment, both for plastics and for metals. The confusion seems to arise primarily because unnotched specimens are usually used for static testing whereas notched specimens are used for impact testing. The notch nearly always dominates the behavior of the specimen and is usually responsible, rather than the increase in speed, for a decrease in energy to fracture. In the special case where conditions are such that $\sigma_{max.}$ and $\tau_{max.}$ reach their critical values nearly simultaneously, only slight changes in the notch, the temperature, the size and shape of the specimen, or the internal structure of the material may result in a transition from ductile to brittle failure, or vice versa. It is in or near this transition region that changes in speed will have the greatest effect on impact strength.

Ductile-brittle transitions have been observed in metals by varying speed alone, and many plastics would undoubtedly show a similar behavior. The closely related phenomenon of raising the yield point by increasing stressing rate is easily observed for such plastics as cellulose acetate and cellulose nitrate in tension. It is reasonable to assume that, as the stressing rate is increased more and more for these materials, eventually a point will be reached at which the yield stress (or critical shearing stress) is equal to or exceeds the cohesive strength (or critical tensile stress). For speeds above this critical speed, brittle failure would be produced. However, it appears that the cohesive strength of normally ductile plastics increases with speed about as rapidly as does the yield point. Thus the impact strength change may be relatively small for large changes in testing speed. A doubling of impact strength frequently corresponds to an increase in speed of several hundred- or thousand-fold.

[3] Analyses of this kind may be found in S. Timoshenko's "*Strength of Materials*," Vol. I, pp. 173 and 296, D. Van Nostrand Co. (1940).

TABLE I CHARACTERISTICS OF TEST SPECIMENS

SPECIMEN TYPE	DESCRIPTION OF STRESS	OPPORTUNITY FOR DUCTILE DEFORMATION	DEPENDENCE OF ENERGY ON DIMENSIONS
TORSION	NON-UNIFORM $\frac{\sigma_{max.}}{\tau_{max.}} = 1$	GOOD	$W_E = \frac{1}{4} V \frac{\tau^2}{G}$ (EQ. 3) $W_P = ?$
TENSION	UNIFORM $\frac{\sigma_{max.}}{\tau_{max.}} = 2$	FAIR	$W_{TOTAL} = K V$ (EQ. 4) K = AREA UNDER STRESS-STRAIN CURVE.
CANTILEVER BEAM, UNNOTCHED	NON-UNIFORM $\frac{\sigma_{max.}}{\tau_{max.}}$ (1. UNNOTCHED, 2. NOTCHED)	SOMEWHAT LESS THAN FOR TENSION	$W_E = \frac{1}{18} V \frac{\sigma_{max}^2}{E} \left(1 + \frac{3L}{2D} \frac{E}{G}\right)$ (EQ. 5) $W_P = ?$
SIMPLE BEAM, UNNOTCHED, CENTRALLY LOADED	NON-UNIFORM $\frac{\sigma_{max.}}{\tau_{max.}}$ (1. UNNOTCHED, 2. NOTCHED)	SOMEWHAT LESS THAN FOR TENSION	$W_E = \frac{1}{18} V \frac{\sigma_{max}^2}{E} \left(1 + \frac{3L}{2D} \frac{E}{G}\right)$ (EQ. 6) $W_P = ?$

TABLE II.—EXPERIMENTAL AND CALCULATED VALUES FOR THE ENERGY REQUIRED TO FRACTURE AN UNNOTCHED BEAM IN SIMPLE THREE-POINT LOADING

Material	*Energy-to-fracture unnotched specimen*		
	Calculated from Eq. 6 of Table I	*Experimental—area under P-S curve*	*Experimental—unnotched Charpy (higher speed)*
	ft.-lb.	*ft.-lb.*	*ft.-lb.*
Woodflour-filled phenolic; machined face in tension	0.178	0.168 ± 0.018	0.265 ± 0.031
Asbestos-filled phenolic; machined face in tension	0.100	0.107 ± 0.015	0.231 ± 0.024
Woodflour-filled phenolic; molded face in tension	0.307	0.300 ± 0.053	...
Asbestos-filled phenolic; molded face in tension	0.190	0.158 ± 0.020	...

Effect of temperature

The strength of plastics is, in general, considerably more sensitive to temperature changes than is that of metals. Accompanying their change in strength with temperature, a change in ductility or in ability to deform for a given stress ratio ($\sigma_{max.}/\tau_{max.}$) may be expected. Also, the dependence of deformation on time is known to change considerably with temperature (14). The change of each of these variables (strength, ductility and creep or speed characteristics) with temperature will have its effect on impact strength.

Experimental results

Dependence of impact energy on dimensions—As already indicated, a large and important branch of the plastics family,

namely, the thermosetting plastics, fail with little or no ductile deformation. For ordinary rates of loading, their stress-strain curves and load-deflection curves are essentially straight lines all the way out to the point of failure (Fig. 1). This fact, coupled with the fact that their total strain at failure is small, makes it possible to describe their impact strength, or the energy absorbed in deforming them up to the point of initial fracture, by means of the equations given in Table I. In applying these equations, however, it must be remembered that the tensile strength and moduli values may be considerably higher at high rates of loading, as encountered in impact, than for loading rates used in static tests.

Table II presents data for the energy-to-fracture calculated by means of Equation 6 of Table I from experimentally determined values of $\sigma_{max.}$, E and G. For comparison, values are listed for the energy determined experimentally from the area under the load-deflection curve of each material. In the first two cases, data were also available for unnotched Charpy impact values. The rate of stressing in the Charpy impact test was approximately 30,000 times as rapid as in the static flexural test from which the data in the second column were obtained. The agreement between columns one and two reflects the fact that the constants used for calculating the theoretical value ($\sigma_{max.}$, E and G) were those obtained from static tests. More experimental evidence will be given below under the heading "Rate of stressing," which indicates that the energy to fracture ($\sigma_{max.}$), and also possibly E and G, increase with an increase in the rate of stressing.

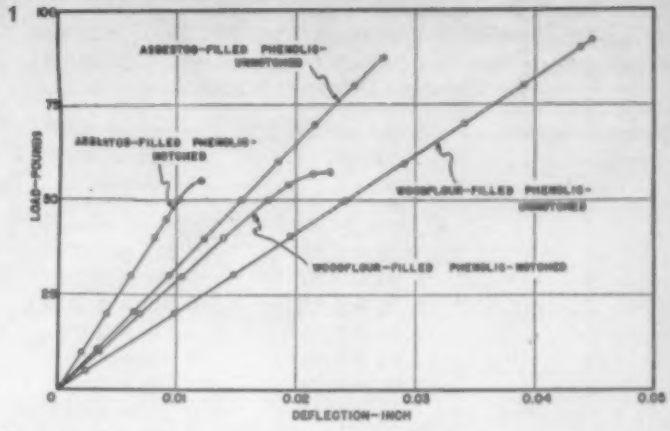
Figure 2 gives experimental points for specimens of varying dimensions of C.R.-39 resin obtained by Marks. These points are seen to be in general agreement with the four theoretical curves, which represent the Equation 6 for each of the four different values of span used.[4]

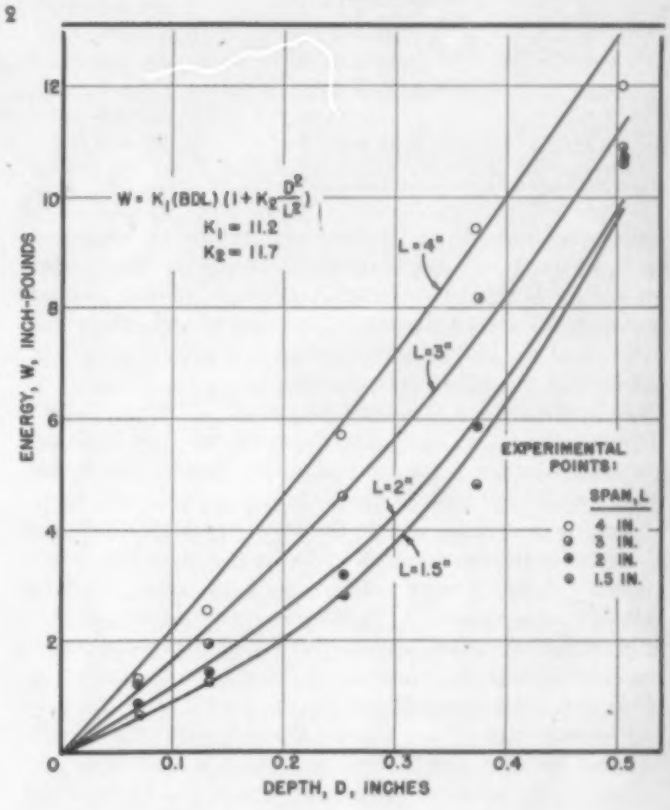
The notch—Figure 3 shows the surprisingly large reduction in energy-to-fracture which is produced by a standard A.S.T.M. notch in Izod specimens. It is apparent that for some of these materials, very little elastic strain energy can be stored throughout the volume of the specimen before the stress in the localized region below the notch has increased sufficiently to result in fracture.

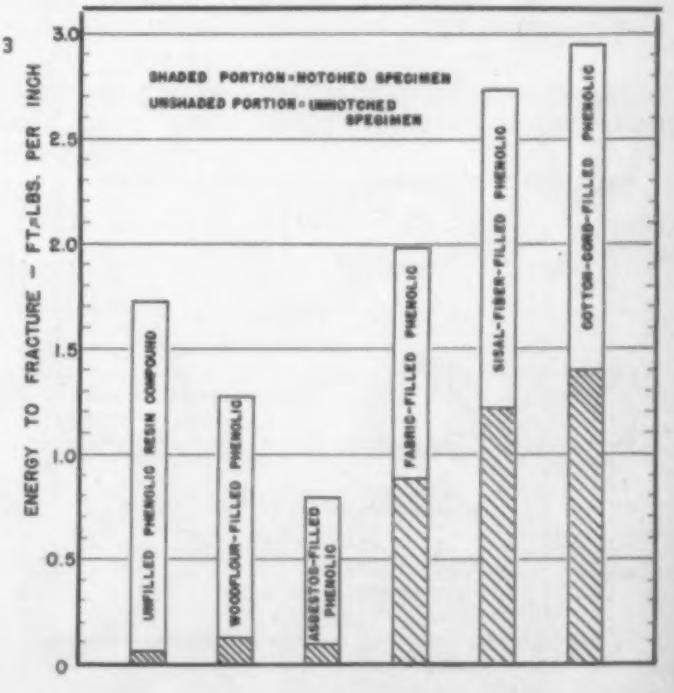
The authors have evidence that the variation of energy-to-fracture with the dimensions of notched specimens may be described by an equation of the same form as Equation 6, but with different constants (Fig. 4). However, it is unlikely that such an equation would remain valid as dimensions are varied over a relatively wide range.

Fibrous fillers—The incorporation of fibrous fillers in brittle resins has the very desirable effect of reducing the notch-sensi-

[4] Since the writing of this paper Mr. Marks, Columbia Chemical Div., Pittsburgh Plate Glass Co., has presented further data on this subject before Subcommittee VIII on Research of A.S.T.M. Committee D-20 on Plastics in New York on June 27, 1944. His data are further evidence of the suitability of an equation of the same form as Equation 6 for describing the dependence of impact strength on dimensions for unnotched specimens.







***1**—Flexural load-deflection curves for 2 phenolic materials. (Notched samples had a depth of 0.5 in., with 0.4 in. below the notch. Unnotched specimens had a uniform depth of 0.4 in.). **2**—Theoretical expression for the energy required to fracture an unnotched, simply-loaded beam with the constants K_1 and K_2 chosen so as to fit experimental points for four different spans. (Experimental data supplied by H. E. Marks). **3**—Comparison of the energy to fracture a notched specimen (indicated by shaded portion) with that required to fracture an unnotched specimen (represented by the total height)*

TABLE III.—EFFECT OF DIFFERENT NOTCHING APPARATUS AND TECHNIQUE ON THE IZOD IMPACT STRENGTH OF A CELLULOSE-ACETATE AND A PHENOLIC MATERIAL

Specimen notched by laboratory	*Sheeted cellulose acetate*[a]	*Compression-molded woodflour-filled phenolic*[a]
	ft.-lb./in. of notch	*ft.-lb./in. of notch*
A	1.28 ± 0.30	0.271 ± 0.009
B	1.30 ± 0.19	0.259 ± 0.012
C	1.35 ± 0.13	0.268 ± 0.012
D	1.44 ± 0.23	0.263 ± 0.018
E	1.64 ± 0.09	0.262 ± 0.008
F	1.69 ± 0.12	0.266 ± 0.013
G	1.68 ± 0.27	0.270 ± 0.012
H	1.73 ± 0.34	0.269 ± 0.010
I	1.89 ± 0.23	0.266 ± 0.010
J	1.92 ± 0.12	0.276 ± 0.011
K	2.05 ± 0.26	0.268 ± 0.010
L	2.11 ± 0.09	0.265 ± 0.010
M	2.24 ± 0.15	0.287 ± 0.022

[a] Nineteen specimens were averaged for each value given. The plus and minus limits are the average deviations.

tivity. As shown in Fig. 3, the energy required to initiate a crack at the base of the notch (E.T.F. value) is considerably greater for fibrous-filled materials than for non-fibrous-filled materials or for unfilled resins. This effect is again illustrated in terms of the load in flexure required to initiate a crack at the base of the notch, by comparing the loads at failure as given by Fig. 1 (non-fibrous fillers) and Fig. 6 (fibrous fillers). Figure 6 also shows how, after the crack has been initiated, the load does not fall to zero as in the case of non-fibrous fillers, but falls off gradually as the broken ends are torn apart.

Judging from these effects, the fibers apparently have the ability to distribute the stress at the base of the notch over a greater volume, thereby reducing its peak value. Thus, a greater load is required to produce a crack. After the crack is produced, the fibers apparently block the propagation of the crack by allowing a portion of the stress to be carried by fibers above the advancing edge of the crack. Thus the load continues to rise (in the notched flexural test) after a crack has been initiated, and the load decreases in a series of sudden breaks as the crack is propagated across the fibrous-filled specimen. In contrast to this, the inception of the first crack results in complete failure for materials without fibrous fillers.

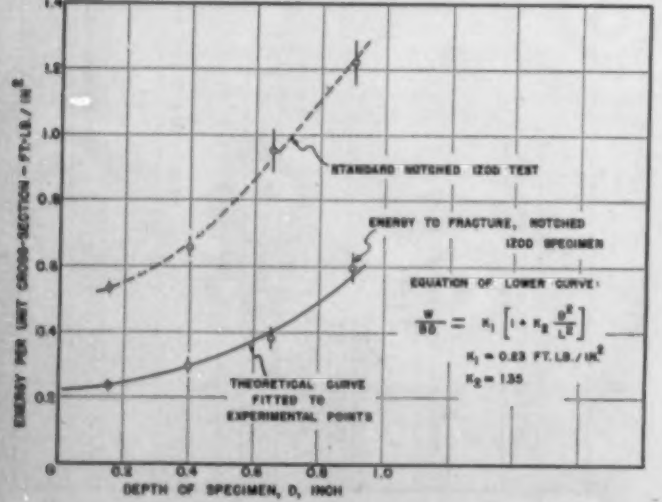
Notching technique—When one considers the action of the notch in localizing or concentrating stress, and in imposing a state of stress which inhibits plastic deformation, it is not surprising that the method or technique used in notching is of importance. Table III illustrates the effect of different notching techniques on the A.S.T.M. Izod impact strength of two materials, a molded woodflour-filled phenolic and a sheeted cellulose-acetate plastic. Twelve plastics testing laboratories participated in the notching of these materials, each notching 19 specimens of each material according to their usual methods and techniques of producing a "standard" notch. Considerable variation in notch radius and angle, and in general appearance of the notch resulted. The large differences obtained for the cellulose acetate may be associated with the fact that the latter is normally a ductile material, but notched specimens are apparently in a ductile-to-brittle transition region at approximately room temperature (see Fig. 5). Besides using a cutter with the specified angle and radius (45° and 0.010 in.), it appears to be very important that the cutting edge is sharp and free from nicks or irregularities of any kind. The sharpness of the cutting edge is especially important in the notching of ductile plastics, such as cellulose acetate where a dull or blunt edge produces strain hardening of the material around the base of the notch. Thus its critical shearing stress, or yield point, is raised and it behaves somewhat as would a brittle surface layer, allowing a crack to start more readily.

Rate of stressing—In our opinion there exists a definite need for more data on this variable. The limited amount of data which are available at present indicates that all plastics are essentially visco-elastic materials, and as such are more or less sensitive to changes in the rate of stressing. On the low rate end of the scale, data on long-time tensile strength and on creep under constant load indicate that extremely low rates of stressing may result in tensile strengths in some instances of less than one-third of the value obtained in standard tests which are run at a stressing rate of approximately 3000 p.s.i. per minute.

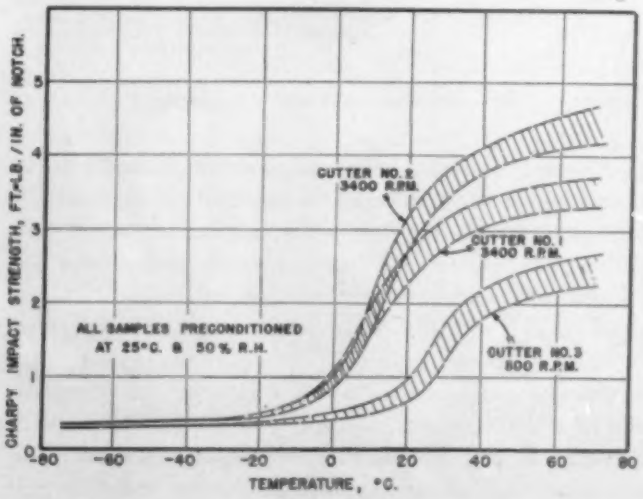
Figure 7 gives the relationship between tensile strength and rate of stressing in tension. The two points located between stress rates of 10^{-2} and 10^{-1} p.s.i. per min. were estimated roughly from long-time tensile strength measurements. The point corresponding to a stressing rate of nearly 10^{6} p.s.i. per min. was calculated from the measured value of the energy

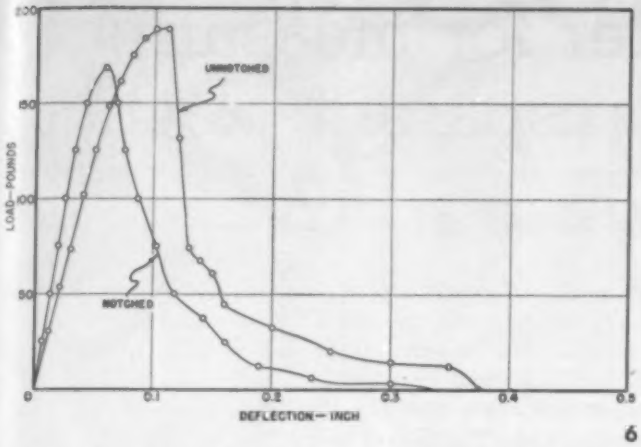
4—Theoretical curve for a notched Izod specimen fitted to experimental points by proper choice of constants. 5—Charpy impact strength of cellulose acetate versus temperature, including effect of using different notching cutters

4


ENERGY PER UNIT CROSS-SECTION - FT-LB./IN.²
DEPTH OF SPECIMEN, D, INCH
STANDARD NOTCHED IZOD TEST
ENERGY TO FRACTURE, NOTCHED IZOD SPECIMEN
EQUATION OF LOWER CURVE:
K₁ = 0.23 FT. LB./IN.²
K₂ = 1.35
THEORETICAL CURVE FITTED TO EXPERIMENTAL POINTS

5


CHARPY IMPACT STRENGTH, FT.-LB./IN. OF NOTCH
TEMPERATURE, °C.
CUTTER NO. 2 3400 R.P.M.
CUTTER NO. 1 3400 R.P.M.
CUTTER NO. 3 800 R.P.M.
ALL SAMPLES PRECONDITIONED AT 25°C. & 50% R.H.



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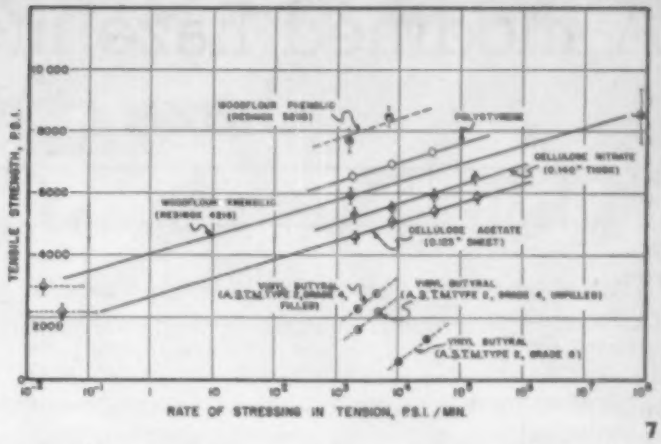


7

6—Flexural load-deflection curves for two specimens—one notched and the other unnotched—of a fabric-filled phenolic molding material. **7**—*This chart shows the effect of stressing rate on the tensile strength of various plastics*

absorbed in breaking an unnotched Charpy impact specimen by using the equation given above. The value calculated was actually maximum fiber stress in flexure, but because data for specimens with machined surfaces were used, the maximum fiber stress was very nearly the same as that of the tensile strength.[5]

All points lying in the 10^3 to 10^6 p.s.i. per min. range, except those for the vinyl butyrals, were obtained on a universal testing machine, 10,000-lb. range, by testing at the various fixed speeds available. The two points for Resinox 5293, a woodflour-filled phenolic, have larger limits of uncertainty than do the remaining points.

The parallelism of the lines representing three distinctly different plastic materials—woodflour-filled phenolic, polystyrene and the cellulose plastics—is surprising. Each of these lines may be expressed by an equation of the form:

$$\sigma_{max.} = K_1 \log \left(\frac{d\sigma}{dt}\right) + \sigma_0 \qquad \text{(Equation 7)}$$

where $\sigma_{max.}$ is the tensile strength, $d\sigma/dt$ is the rate of stressing, σ_0 is a constant, characteristic of the material, and K_1 is the slope—approximately the same for all of these materials. The experimental points for the polyvinyl butyral plastics indicate that their tensile strength is much more sensitive to changes in speed than is that of the other plastics investigated.

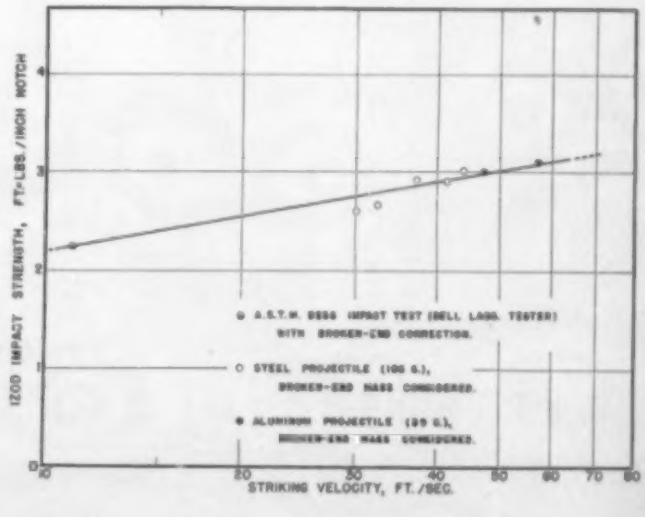
Intuitively, one would expect the slopes of these curves to "level off" or approach zero both for extremely low and extremely high speeds. Indeed, the data for the polyvinyl butyrals indicate that they would have zero tensile strength for stressing rates somewhere between 10 and 10^4 p.s.i. per min., unless the curves decrease in slope at lower rates. Further experimental work conducted along this line will be very interesting.

Figure 8 shows the notched Izod impact strength of a fabric-filled phenolic plotted against impact speed on semi-log coordinates. The speed of the striking piece just before contacting the specimen is plotted in each case. The low-speed point was obtained by using the A.S.T.M. standard test method and a standard pendulum impact machine. The remaining points were obtained with a compressed-air gun which fired a blunt-nosed projectile at a standard notched Izod specimen. A ballistic pendulum was used for measuring projectile speeds and energy absorption. Because of the relatively high scatter of the high velocity points, it is difficult to draw conclusions as to any definite relationship between impact strength and speed, except that increased speed results in increased impact strength, up to velocities as high as 60 ft. per second. Assuming that the relationship is of the form of Equation 7, it is seen that the K_1 value (or slope) must be considerably greater in this case. The presence of the notch probably results in greater sensitivity to changes in speed, and may thus be responsible for the greater slope.

Temperature—Considerable data on the dependence of the impact strength on temperature have already appeared (17–21, 29). In general, the impact strength of the more brittle thermosetting materials varies only slightly over a considerable range of temperatures. The thermosetting resins containing fibrous fillers tend to increase in impact strength up to a critical temperature (usually from 150 to 200° C.) after which they drop off rapidly.

The effect of heat-aging is of importance for many plastics. After being subjected to a temperature as low as 135° C. for a period of several hundred hours, the impact strength of most of the organic-filled thermosetting plastics begins to drop considerably. Inorganic fillers show no appreciable breakdown for temperatures below about 200° C. For specific information on the effects of continued heating on impact strength of phenolic materials, the reader is referred to an earlier paper (23). (*Please turn to page 186*)

8—*The effect of striking velocity on the Izod impact strength of a fabric-filled phenolic molding material*



[5] Experimentally, the maximum fiber stress for machined surfaces and tensile strength are approximately the same for normal rates of stressing, and there is no obvious reason why they should not also be the same in the case of high speeds.

A modified haze meter for measuring haze of transparent plastics*

by E. DILIBERTI and D. H. KALLAS**

THE widespread use of transparent plastic sheet material for applications requiring good optical properties has increased the necessity for suitable measuring apparatus for the quantitative determination of the effect of various factors on the visibility through this plastic sheet. Some of the most important of the factors affecting visibility are traceable to surface defects, internal non-uniformities and optical disturbances which cause "light scattering." "Light scattering" has been commonly called haze and is defined by the American Society for Testing Materials[1] as "that fraction of the total transmitted light from a normally incident beam which is not transmitted in a straight line."

The need for suitable apparatus for the measurement of the property described above, has increased appreciably in recent years because of the more extensive use of transparent plastics for military equipment such as aircraft enclosures, instrument windows, safety equipment and navigation instruments. The large volume of material used for these critical military applications has necessitated strict requirements by various Government agencies to insure procurement of high-quality material. Of course, elaborate methods and expensive apparatus for determining the optical characteristics of transparent materials are at present available or can be set up. However, it is evident that what has been most urgently needed is apparatus which embodies the fundamental requisites of simplicity of construction, low cost and reasonable accuracy.

A survey of available equipment and methods has shown that the apparatus commonly known as the Axilrod-Kline-Bowen[2] haze meter embodies the requisites outlined above and is considered entirely satisfactory, especially since the method has been adopted by various Government agencies. The purpose of this paper is to present improvements and modifications suggested by extensive use of the existing type of instrument. It must be noted that these changes do not alter the basic principles of the haze meter as included in existing specifications, but are actually refinements which, it is believed, will lead to more consistent results, simpler operation and adaptability to inspection and production control work.

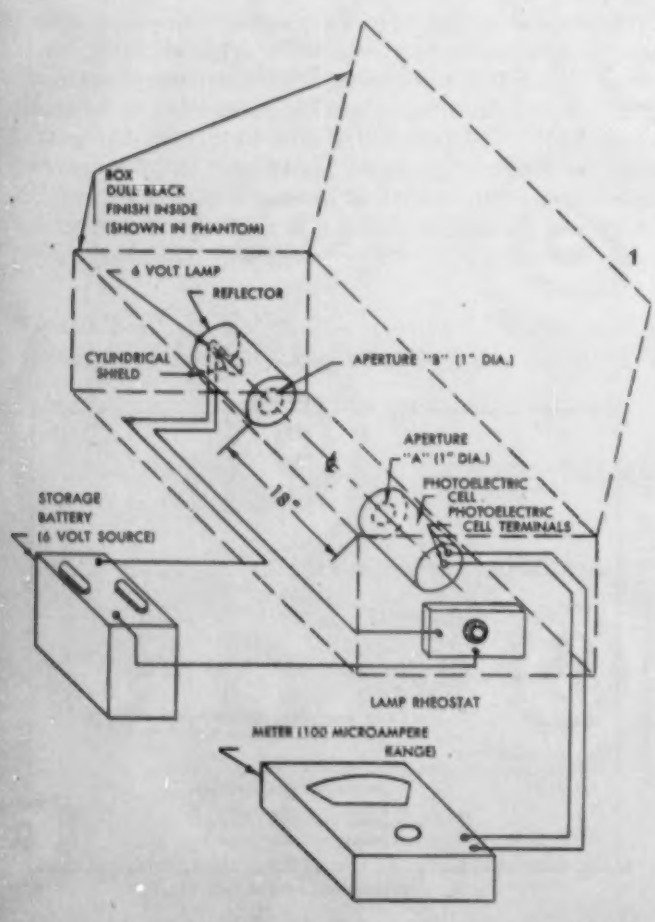
The Axilrod-Kline-Bowen haze meter, illustrated by a diagrammatic sketch in Fig. 1, consists essentially of a light source, a photoelectric cell and a microammeter. The light source is a 6-v. automobile-type lamp housed in a cylindrical container fitted with a reflector and a 1-in.-diameter aperture to permit the projection of what is intended to be a collimated beam of light. A diaphragm with a 1-in.-diameter aperture is mounted directly in front of a photoelectric cell 18 in. from the aperture of the lamp housing. The apertures and photoelectric cell are axially aligned and in parallel planes. The photoelectric cell (Weston type I or III with Viscor filter) is of the corrected type which has a spectral response similar to that of the human eye. The output current of the cell is measured with a meter that has a range of 100 microamperes and an internal resistance of 50 ohms. This apparatus is usually assembled on an optical bench in a dark room or is mounted in a light-tight wooden (*Please turn to page 188*)

* The opinions or assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

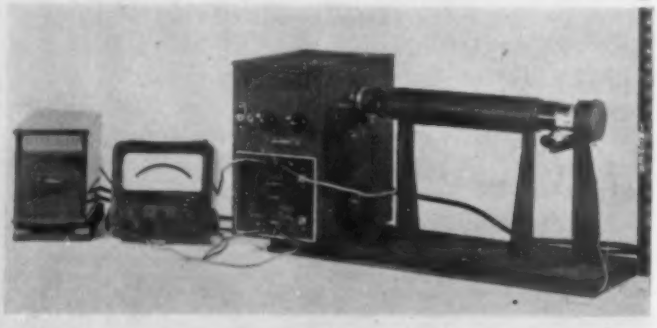
** Material Laboratory, Navy Yard, N. Y.

[1] Tentative Method of Test for Haze of Transparent Plastics by Photoelectric Cell; A.S.T.M. designation D 672–42 T.

[2] "Methods of Testing Plastics," by G. M. Kline and B. M. Axilrod, Ind. Eng. Chem. *28*, 1170 (Oct. 1936).



1—The haze meter, shown here in a diagrammatic sketch, consists essentially of a light source, a photoelectric cell and a microammeter. 2—Redesigned to include a commercial projector instead of a conventional light source, and operating from regulated voltage supply, this haze meter has been found to give more satisfactory results


2

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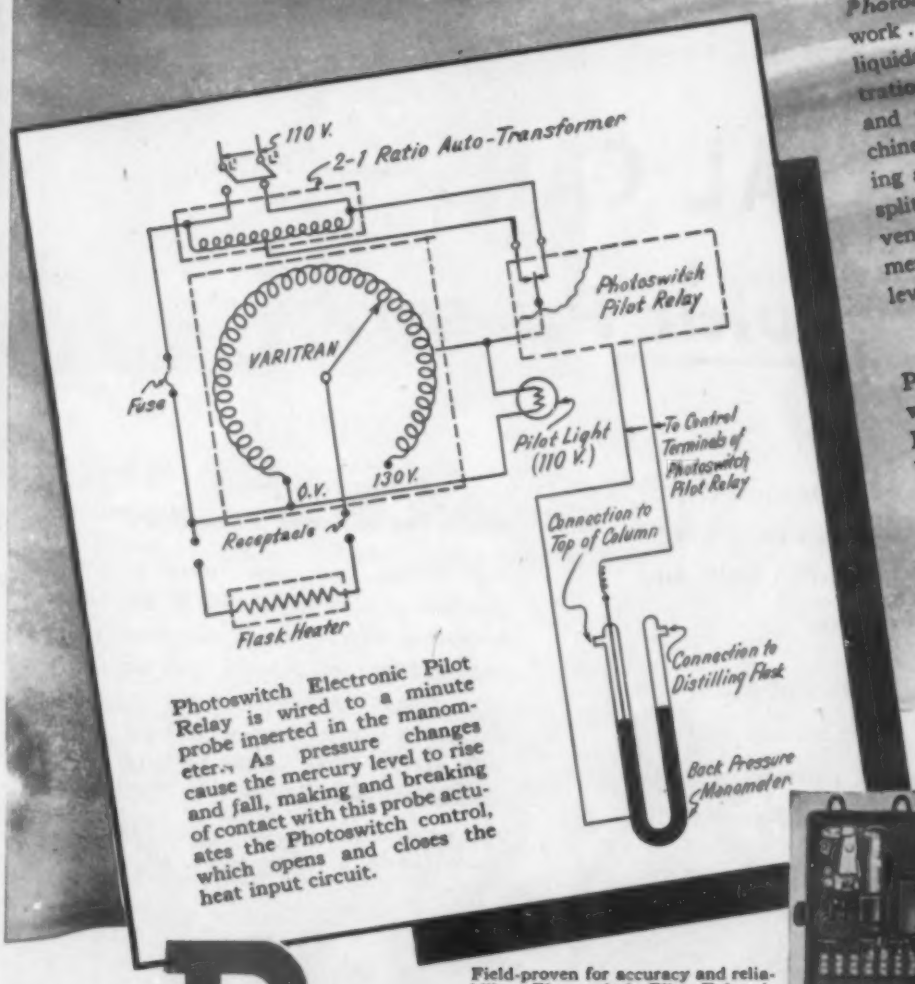

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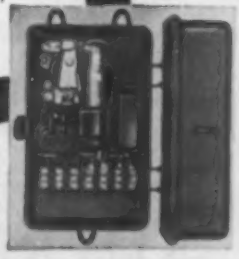

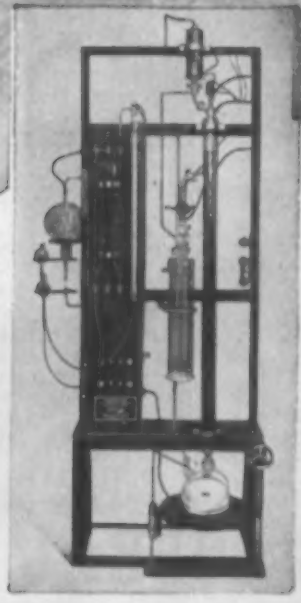

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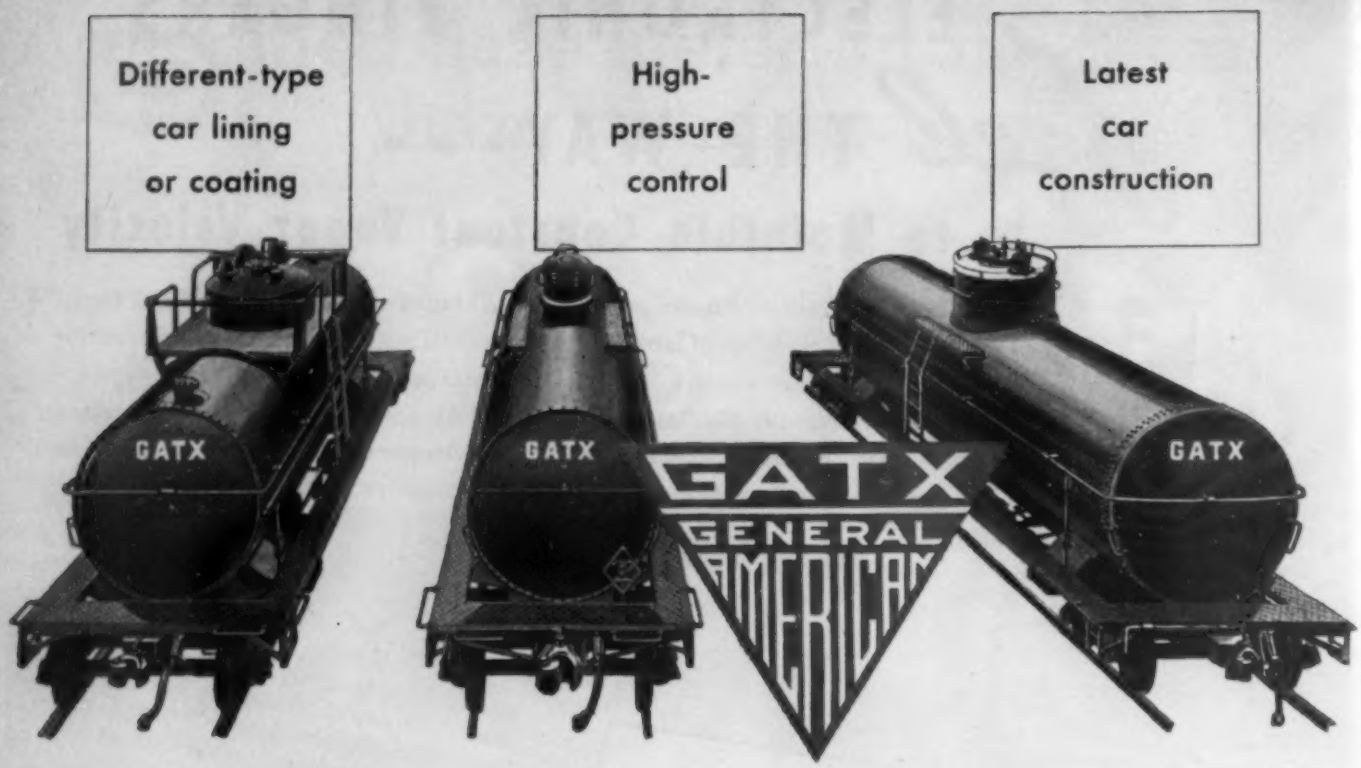

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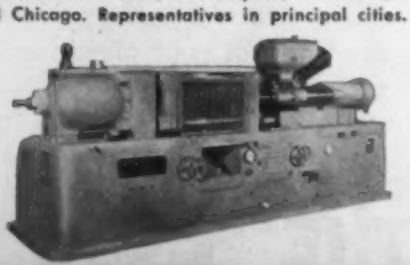

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Engineering

FAIRLEAD MADE BY CYCLEWELD PROCESS. Rubber Age *56*, 403 (Jan. 1945). The manufacture of a new type of fairlead for airplanes from a piece of plastic and pieces of rubber bonded with Cycleweld is described.

THE TECHNOLOGICAL COMING-OF-AGE OF WOOD. F. J. Champion. British Plastics *16*, 534-40 (Dec. 1944). Technological developments in wood are described. Topics include prefabricated plywood buildings, glued and laminated structures such as large arches, bag molding, resin-impregnated laminated wood, resin-impregnated compressed laminated wood, lignin-cellulose molding compounds and laminates, resin-impregnated paper laminates as well as urea-plasticized wood.

PLASTICS FOR THE ENGINEER. I. W. A. Kirkwood and P. D. Richie. J. Inst. Production Engrs. *23*, 91-153 (1944). This is a review of plastics. X-ray technique is used along with other tests in production to check the quality of the molded plastic products which are being manufactured.

PLASTICS FOR AIRCRAFT WIRING. British Plastics *16*, 545, 552 (Dec. 1944). A new wiring system which is now standard for all British aircraft is described. It consists essentially of a series of connector blocks with plug-in leads. By means of this system and of parts made of plastic, the installation of electrical wiring and repair of aircraft are simplified.

LINING TANKS WITH PLASTICS. A. Sirot. Kunststoffe *33*, 33-9 (1943); Chem. Abstracts *38*, 5022 (Sept. 20, 1944). Metal, wood and concrete tanks coated with a polyvinyl chloride composition are satisfactory if the prevailing ambient temperature does not exceed that of 50° C.

Chemistry

COMPARISON OF THE STRUCTURES OF STRETCHED LINEAR POLYMERS. M. L. Huggins. J. Chem. Phys. *13*, 37-42 (Jan. 1945). Published x-ray data from crystalline selenium and tellurium and from stretched sulfur (amorphous), polyethylene, polyisobutylene, polyvinyl alcohol, polyvinyl chloride, polyvinylidine chloride, polyoxyethylene, polyethylene disulfide, polyethylene tetrasulfide, and polyphosphonitrile chloride are compared. In most cases the experimental identity distance in the direction of the chain axes and the expected interatomic distances and interbond angles are found to be in agreement with the assumption that the chain atoms form a regular spiral, unidirectional in each chain and of uniform pitch.

PREPARATION AND POLYMERIZATION OF POLYALLYL ETHERS. P. L. Nichols, Jr., and E. Yanovsky. J. Am. Chem. Soc. *67*, 46–9 (Jan. 1945). Allyl ethers of *D*-mannitol, *D*-sorbitol, glycerol, ethylene glycol, 1, 3–butylene glycol, dipropylene glycol, pentaerythritol, inositol and sucrose were prepared and some properties of each were determined. During the passage of oxygen through the liquids at elevated temperatures, there was a gradual increase in viscosity followed by a rapid increase near the point of gelation. After the gelation point was reached, further heating in the presence of oxygen converted the materials containing two or more allyl groups per unit of monomer to hard brittle resins. The solubility of the compounds in acetone and other solvents decreased as the polymerization proceeded and the viscosity increased. The polymerization will not proceed beyond the gel stage in the absence of oxygen even on prolonged heating. The effects of various agents on the polymerization of allyl ethers in the presence of oxygen may be summarized as follows: Metal salts of organic compounds, such as cobalt or manganese naphthenate or linoleate, are strong accelerators of the oxidation and polymerization process. Strong acids, such as sulfuric or perchloric acid, cause extensive discoloration and decomposition at 100° C., even when present in traces. Monochloroacetic acid (0.1 percent by weight) has no effect on the rate of polymerization as determined viscometrically. Alkalies, such as aqueous sodium hydroxide or benzyltrimethylammonium hydroxide, completely inhibit polymerization.

THE STRUCTURE OF COPOLYMERS. F. T. Wall. J. Am. Chem. Soc. *66*, 2050-7 (Dec. 1944). Using the concepts of Norrish and Brookman, a general theory of copolymerization is developed which involves relative polymerization velocities as functions of the monomer composition. The treatment is developed in analogy to vapor pressures of binary systems. The ideal systems (corresponding to "Raoult's Law" type of behavior) are suggested as starting concepts from which deviations might be observed. Non-ideal copolymerization systems can sometimes lead to "azeotropic copolymers." The nature of such "azeotropes" together with their intramolecular distributions are considered. The behavior of certain polymerization systems, particularly those leading to so-called heteropolymers, are accounted for by the theory.

Properties

CHANGE IN STRUCTURE OF CELLULOSE NITRATE FILMS ON RELAXATION. V. A. Kargin, P. V. Kozlov and R. V. Zueva. J. Phys. Chem. (U. S. S. R.) *17*, 318-25 (1943); Chem. Abstracts *38*, 6146 (Nov. 20, 1944). The structural changes that take place when cellulose nitrate films are subjected to rapid deformations were studied by x-ray and double refraction techniques. When the load is released from stretched cellulose nitrate film, it undergoes a two-stage relaxation process. The first is marked by a sharp decrease in the double refraction and the vanishing of x-ray texture structure. The life of the first stage is measured in minutes after the film is heated to 100 to 150° C. The second stage of relaxation proceeds so slowly that the film seems to be stable and optically anisotropic. With benzyl cellulose films, the relaxation proceeds faster but leads to an isotropic product.

FLAME RESISTANCE OF THERMOSETTING PLASTICS. J. A. Gale, R. W. Stewart and J. B. Alfers. A.S.T.M. Bull. No. 131, 23–27 (Dec. 1944). A method for determining the flame-resistant characteristics of thermosetting plastics ordinarily classified as self-extinguishing is presented. A flame resistant material possesses the following characteristics: 1) high ignition temperature, 2) low burning time, 3) absence of smoldering after the flame is extinguished, 4) retention of mechanical strength after burning, and 5) minimum distortion caused by exposure to test conditions. Considerable difference in ignition time and burning time was noted between the respective types and between samples of the same type, as supplied by different manufacturers. Reproducibility of results, however, for different samples of the same material was good. With respect to ignition and burning times, it was found that the melamine resin plas-

tics had better flame-resistant characteristics than most of the phenolic resin materials. Generally, the mineral-filled materials (including asbestos and glass-base materials) were found to be least affected by exposure to test conditions. They retained some semblance of mechanical strength after burning and resisted the effect of flame to a greater extent than the cellulose-filled materials. All of the cellulosic-type specimens either carbonized completely or continued to smolder after being tested. Mechanical strength was nil in both instances. Smoldering would be particularly undesirable, because of the possibility of ignition of explosive gas mixtures when in confined quarters. The most flame-resistant types are the mineral-filled and glass-fabric-base melamine-formaldehyde plastics. This method of test affords a quantitative indication of the comparative flame resistance of materials formerly classified only as self-extinguishing. The differences in the flammability characteristics, as imparted by the inherent properties of the particular resin, type of filler, molding technique, etc., are sufficiently divergent and can be determined with sufficient accuracy to permit the establishment of limits of flammability on this basis.

EFFECT OF ULTRAVIOLET LIGHT ON CELLULOSE ACETATE AND NITRATE. T. S. Lawton, Jr., and H. K. Nason. Ind. Eng. Chem. *36*, 1128–30 (Dec. 1944). The effect of ultraviolet light on the viscosity of cellulose acetate and cellulose nitrate was studied in atmospheres of air, nitrogen and oxygen. In air and oxygen the degradation of the cellulose esters is accelerated. The effect of a nitrogen atmosphere is to retard degradation. In all atmospheres the drop in viscosity for cellulose acetate was gradual; for cellulose nitrate the viscosity dropped more rapidly during the initial part of the exposure and then leveled off.

Testing

THE EVALUATION OF TEAR RESISTANCE IN ELASTOMERS. F. L. Graves. India Rubber World *111*, 305–8, 317 (Dec. 1944). The fundamental fault in the stress distribution of the crescent tear specimen is discussed. A new angle tear specimen was developed with improved stress distribution. The specimen provides greater concentration of the pulling force at the point of tearing. The need of razor nicking the test pieces is eliminated, resulting in a marked improvement in the uniformity of tear-resistance data. Tests carried out on 4 elastomers indicate that the crescent specimen values are dominated by the modulus and ultimate elongation of the material. Data obtained with the angle tear specimen indicate that tear resistance is a complex function of tensile strength and ultimate elongation.

THE USE AND EVALUATION OF SOME SPECIALTY ADHESIVES. F. J. Wehmer. Rubber Age *56*, 397-400 (Jan. 1945). Test methods used for the evaluation of adhesives are discussed. The force of adhesion is evaluated by direct tensile tests, by shear tests and by peeling or stripback tests. Tensile tests give the highest results, shear, intermediate and peeling the lowest. Other tests include constant strain at low intensity and resistance to aging. An apparatus for evaluating sealers for use in the construction of pressurized cabins of airplanes is described.

MOISTUREPROOF WRAPPINGS. W. Berry. Plastics (London) *9*, 33-5 (Jan. 1945). This is a discussion of the factors involved in determining the permeability of wrapping materials to moisture vapor.

OPTICAL METHODS FERRET TRANSPARENT-PLASTIC DISTORTIONS. T. Gladwin. Aviation *44*, 147-8, 254-6 (Jan. 1945). Test methods for determining the optical properties of formed acrylic resin sheets are described in this article.

Synthetic rubber

PLASTICATION AND PROCESSING OF GR-S. G. R. Vila. Ind. Eng. Chem. *36*, 1113–19 (Dec. 1944). The plastication and processing of GR-S were investigated to determine the interrelations involved. On the basis of the results obtained, the following conclusions are drawn: Viscosity measurements on the completed compound bear a direct relation to the heat generated and the power consumed during extruding but do not correlate with extruding speeds. Power consumption and heat generation during extruding increase directly with increasing worm speed. Extruding speed is a function of worm speed and the surface condition of the compound; higher degrees of surface smoothness resulting in faster extruding speeds. The relative increase in cross-sectional area or degree of swell of the extruded rod varies inversely with relative surface smoothness of the compound; that is, smoother compounds exhibit a lower degree of swell. The extruding characteristics of a compound may be predicted with a reasonable degree of accuracy from knowledge of the viscosity or the plasticity of the finished compound in conjunction with an estimate of its relative surface smoothness. Surface smoothness may be achieved by hot breakdown, increasing softener ratios, or increasing ratios of carbon black. High-temperature plastication tends to exert a deleterious effect on the physical properties of the subsequent vulcanizate. Further investigation is required to establish a relation between the relative benzene solubility of the unplasticated polymer and its processing characteristics. Plastication at low temperatures tends to increase benzene solubility of the polymer, whereas plastication at high temperatures reduces it.

SYMPOSIUM ON THE APPLICATIONS OF SYNTHETIC RUBBERS. 134 pp. Published by A. S. T. M., Phila., Pa. (1944). The papers and discussions presented at a meeting of the American Society for Testing Materials in March 1944 are published in this volume. The titles and the authors of the papers are as follows: Introduction, by A. W. Carpenter; "The Origin and Development of Synthetic Rubbers," by H. L. Fisher; "Physical Testing of Synthetic Rubber Products," by L. V. Cooper; "The Physical Properties of the Synthetic Rubbers," by J. M. Ball and G. C. Maasen; "Specifications for Synthetic Rubber Compounds," by M. J. De France; "The Processing Characteristics of the Synthetic Rubbers and Their Use in the Manufacture of Extruded Products," by A. E. Juve; "Synthetic Rubber Tires and Inner Tubes," by P. M. Torrance; "Belting and Hose Made from Synthetic Rubber," by W. L. White; "The Use of Synthetic Rubbers in Molded Products," by M. J. Sanger; "Cellular Rubbers," by L. P. Gould; "Hard Rubber Products from Synthetic Rubbers," by W. H. Juve; "Synthetic Rubbers in the Wire and Cable Industry," by R. A. Schatzel; "Use of Synthetic Rubber in Footwear," by S. Glover; and "Synthetic Rubber Adhesives," by F. J. Wehmer.

ADVANCES IN RUBBER DURING 1944. J. W. Liska. Rubber Age *56*, 293-8 (Dec. 1944). The progress in rubber technology during 1944 is summarized. Topics discussed include: properties of synthetics, compounding, continuous polymerization process, GR-S tires, airplane-tire-testing machine and a symposium on physics in rubber.

COMPOUNDING NEOPRENE LATEX WITH PLASTIC MATERIALS. B. Dales, H. H. Abernathy and R. H. Walsh. India Rubber World *110*, 643-4 (Sept. 1944). Various mixtures of chemicals capable of reacting to form resins and various resins were mixed with a neoprene latex and films formed. The physical properties and the swelling in water and kerosene of the films are reported in tabular form. A wide range of properties was obtained. Most of the films were deficient in some physical property, notably permanent set. Some of the films resembled flexible hard rubber. Other films had excellent resistance to swelling by water. The films made from the latex mixed with the resin-forming reactive chemicals had excellent adhesion to many types of surfaces.

PLASTICS DIGEST

This digest includes each month the more important articles of interest to those who make or use plastics. Mail request for periodicals directly to publishers.

General

A NEW MARKET FOR NEW CHEMICALS: WET - STRENGTH PAPER. K. W. Britt. Chemical Industries *55*, 734-7 (Nov. 1944). High wet-strength papers are prepared by impregnating the paper with uncured resin and polymerizing in situ. The wet strengths of most papers range from 4 to 12 percent of the dry strengths. The wet strengths of paper towels treated with 0.75, 1.5 and 3.0 percent urea-formaldehyde resins retained 26, 53 and 67 percent of the dry strengths, respectively. Wet-strength paper is used for paper towels, maps, blueprint paper, wrappings for moist materials, as well as for building papers.

SILICA AND MELAMINE-FORMALDEHYDE MAKE NEW SPECIALTY TEXTILE COATINGS. Chemical Industries *55*, 916–7 (Dec. 1944). "Syton," a slip-proofing and shine-resisting coating for textiles, is essentially a coating of silica. It is applied from a water dispersion of colloidal silica. It requires no curing and is not removed by laundering or dry cleaning. "Reslooming," a shrinkproofing and crease-resisting coating for textiles, is a coating of melamine-formaldehyde resin. Uncured resin is deposited from an aqueous solution in the fibers and cured in situ by heat.

THE FUTURE OF THE PLASTICS INDUSTRY. A. P. M. Fleming. British Plastics *16*, 527-33, 544 (Dec. 1944). The fundamental factors on which the future of the plastics industry in Great Britain depends are discussed. These include the following: 1) raw materials, 2) physical properties, 3) applications in the electrical industry, 4) organization of research, 5) education and training of personnel, and 6) organization of the industry in general.

PROGRESS IN RAYON. E. B. Laufer. Chem. & Eng. News *22*, 1984-9 (Nov. 25, 1944). The production, consumption, international aspects, prices, new developments and outlook in the rayon industry are discussed.

CURRENT DEVELOPMENTS IN PLASTICS FOR AERONAUTICAL USE. A. Klemin. Aero Digest *48*, 71-3, 203, 205 (Jan. 1, 1945). Current plastics developments which are of interest in aeronautics are reviewed. Continuous injection and extrusion molding of thermosetting plastics, silicone resins, synthetic elastomers and resorcin resins and adhesives are discussed at length.

PLASTICS INDUSTRY CONTINUES TO EXPAND WITH NEW PRODUCTS AND APPLICATIONS. C. Rector. Chem. Eng. News *23*, 150-2 (Jan. 25, 1945). The developments in the plastics industry during 1944 are reviewed and the future outlook evaluated.

A PRACTICAL COURSE IN PLASTICS. J. O. Frank and J. O. Frank. J. Chem. Ed. *22*, 99-101 (Feb. 1945). An outline of a course in plastics is presented.

SURVEY POINTS TO WIDER USE OF PLASTICS IN POSTWAR RADIO AND HARDWARE MANUFACTURE. Pacific Plastics *3*, 16-21 (Jan. 1945). The use of plastics in the manufacture of radio and hardware items is reviewed. Many applications are considered. The results of a survey among the merchandisers of these items are presented. The plastics industry is criticized by this group for misapplications and unstable prices.

DEVELOPMENTS IN TEXTILES IN 1944. M. Harris and G. B. Frankenberg. Chem. Eng. News *23*, 147-9 (Jan. 25, 1945). Developments in textiles during 1944 are reviewed.

Materials

PLASTIC MATERIALS DERIVED FROM MAIZE (CORN). R. O. Mendez. Anales inst. investigaciones cient. tecnol. (Univ. nacl. litoral, Santa Fe, Argentina) *12/13*, 189-92 (1943); Chem. Abstracts *38*, 6423 (Nov. 20, 1944). Gluten from corn or the residue of corn hydrolysis can be molded under heat and pressure to produce translucent plastics of poor water resistance. Addition of formaldehyde or tannic acid does not improve the product. The addition of 5 to 7 percent of urea produces a plastic which is resistant to water. An increase in the urea content decreases water resistance and at 18 to 20 percent no plastic product is formed. The best molding conditions are 230 to 270 kg./cm.^{2} at 120 to 140° C. for 3 to 5 minutes.

THE DEVELOPMENT OF POLYTHENE AS A HIGH-FREQUENCY DIELECTRIC. W. Jackson and J. S. A. Forsyth. Chemistry and Industry *1944*, 390–1 (Nov. 11, 1944). This article is a summary of a talk given before the Institution of Electrical Engineers. Polythene is a high-molecular-weight straight-chain paraffin hydrocarbon which is thermoplastic. The molecular weight ranges from 8000 to 20,000. At normal temperatures it is tough and flexible and remains so at temperatures well below zero. Certain plasticizers, notably polyisobutylene, improve the low-temperature flexibility. Small amounts of anti-oxidants are added to eliminate the deterioration which occurs on heating. Polythene is used mainly for cable coverings. The power factor is 0.00015 to 0.0003. The effects of oxidation and of trapped oxygen from the polymerization catalyst on the power factor is discussed; the effects are deleterious.

UTILIZATION OF LIGNIN BY ZINC SALT TREATMENT. J. Seiberlich. Chem. Ind. *56*, 53 (Jan. 1945). The water absorption of wallboards made from lignin treated with zinc salts was determined. Best results were obtained with Scholler lignin treated with zinc sulfate, with hydrogen sulfide and also with formaldehyde.

OIL-SOLUBLE HYDROXYBIPHENYL - FORMALDEHYDE RESINS. K. A. Andrianov and C. I. Gribanova. J. Chem. Ind. (U. S. S. R.) *18*, No. 9, 17-20 (1941); Chem. Abstracts *38*, 5023 (Sept. 20, 1944). Formaldehyde and hydroxybiphenyls, molal ratio not less than 1.2 to 1, react in the presence of an alkaline catalyst to yield an oil-insoluble resin and in the presence of an acid catalyst to yield an oil-soluble resin. The rate of polymerization and melting point of the resin increases with increasing proportions of formaldehyde. The products may be baked at high temperatures to form insoluble high-melting-point resins. Lacquer films of these resins are stable toward air and water and have good electrical insulating properties.

Molding and fabricating

METALLURGICAL PROGRESS AND THE PLASTICS INDUSTRY. L. Sanderson. British Plastics *17*, 16-18 (Jan. 1945). Some of the wartime applicatons of plastics in metallurgical processes and of metallurgical advances used in the plastics industry are reviewed. These include rubber forming molds for

metals, surface-hardened molds for plastics, improvements in mold steels, protective coatings for metals, steel balls for grinding mills, plastic bearings for metal rolling mills, metal plating of plastics, use of plastics in the "lost wax" method of casting metals, salvaging of porous castings with plastics, and use of plastic coatings for determining stresses in metals.

RADIO-FREQUENCY WELDING OF PVC FILM. S. C. Mitchell. Plastics (London) *8*, 559-63 (Dec. 1944). A radio-frequency welding machine for continuously sealing layers of polyvinyl chloride film is described.

Applications

BEARINGS AND BUSHINGS MADE OF THERMOSETTING PLASTICS. O. Eilbensteiner. Fertigungstech. *1943*, 31–3; Chem. Abstracts *38*, 6005 (Nov. 10, 1944). Paper-base and fabric-base phenolic laminates are used successfully for bearings and bushings. They may be machined from laminates or molded to shape. Cresol-formaldehyde plastics are used where high mechanical strength is required. Plastic bearings are lower in weight, inferior in mechanical strength, have higher thermal expansion and lower thermal conductivity than metals. The plastic materials swell when exposed to moisture and oils, are highly resistant to abrasion, have favorable frictional characteristics and are not sensitive to dust and dirt. The design and construction of plastic bearings are also discussed.

POLYVINYL CHLORIDE FOR PROSTHESES. Plastics (London) *8*, 573-6 (Dec. 1944). Plasticized polyvinyl chloride compositions are successfully utilized in the preparation of surgical prostheses such as noses, ears and fingers. Polyvinyl chloride powders are mixed with liquid plasticizers to form pastes which are readily transformed by heat into flexible rubber-like products. The shape desired is easily obtained by a simple molding operation. Phthalate plasticizers, such as dibutyl and dihexyl, are preferred for this application. The proper colors are obtained with a mixture of cadmium red and zinc oxide. Plaster-of-Paris molds are used. Detailed directions for the steps to be followed in preparing the molds and in making the restorations are given.

VINYL RESINS FOR FOOTWEAR. British Plastics *16*, 541-2 (Dec. 1944). The application of vinyl resin sheeting and of sole leather impregnated with vinyl resins for shoe soles in the U. S. A. is reviewed. The outstanding property of these materials is the high abrasion resistance. Split leather treated with vinyl resins gives greater wear than prime sole leather. Laminated leather and leather-plastic soles and insoles made of a combination of cellulose and leather fibers bonded with synthetic rubber are also described.

PLASTICS IN MEDICINE. A. MacGowan. British Plastics *17*, 30-2, 35, 45 (Jan. 1945). Some of the uses of plastics in the manufacture of medical apparatus and equipment are discussed. Acrylic resins are used to make speculums, retractors, lighting devices, gastroscopes, splints, dentures, spectacle lenses, covers for skull defects, bridges for fractures and joint caps. One of the outstanding properties of plastics for these applications is the remarkable inertness of body tissues to plastic materials. With the exception of one or two materials, the implantation of plastics in the body has no harmful effect. No other known materials have this property.

WEATHERPROOF SOLID FIBERBOARD. F. A. Simmonds, J. N. McGovern and C. O. Seborg. Fibre Containers *29*, No. 7, 20, 22, 24, *29* (July 1944). Improvements in commercial weatherproof solid fiberboards of the V-type are described. These improvements are attributed to 1) the use of a wet-strengthening treatment consisting of 4 percent melamine resin, 3 percent rosin size, 1 percent wax size and alum to give a pH of 5 which is added to the stock in the beater; 2) the use of a greater number of individual plies of high dry strength sheet; and 3) an increase in the amount of water-resistant adhesive used in laminating the solid fiberboard.

PLASTICS IN THE TOY TRADE. H. F. Page. Plastics (London) *9*, 18-22, *29* (Jan. 1945). The use of plastics in making toys is discussed. The design of toys and molds for the toys are important if success in the use of plastics for this purpose is to be obtained. Most of the failures have been caused by 1) poorly designed toys, 2) improper material, and 3) improperly designed molds. It is recommended that the advice of plastics experts be used in the design and production of toys from plastics. Several types of toys made from plastics are illustrated.

Coatings

PROTECTIVE COATINGS INDUSTRY. J. J. Mattiello. Chem. Eng. News *23*, 136-43 (Jan. 25, 1945). Developments in the protective coating industry during the war period are reviewed. The fact that the protective coating industry is a chemical and engineering industry rather than a branch of the arts has been emphasized by the war. Affected by raw material problems, it has had to devise substitutes, and it has adequately accomplished the feat of meeting military requirements and civilian needs.

ANTIFOULING PAINTS. G. H. Young, W. K. Schneider and G. W. Seagren. Ind. Eng. Chem. *36*, 1130–2 (Dec. 1944). An increase in the copper content of anti-fouling paints leads to an increase in over-all performance. Also, the addition of inert pigment to copper-containing formulations further increases their anti-fouling efficiency. A mechanism for anti-fouling action is advanced.

NITROCELLULOSE LACQUERS. W. Koch, H. C. Phillips and R. Wint. Ind. Eng. Chem. *37*, 82-6 (Jan. 1945). It is shown that the nonvolatile content of cellulose nitrate lacquer can be increased by using lower-viscosity cellulose nitrates and larger proportions of nonoxidizing alkyd resins with a more active solvent, or by applying the lacquers at an elevated temperature up to 70° C. The gain in nonvolatile content contributed by each factor is cumulative, so that quite high solids are possible. To maintain high-quality performance, the cellulose nitrate used should be the 30-35 centipoise type or higher, and the proportion of nonoxidizing alkyd resin should not exceed a 1:2 ratio of cellulose nitrate to resin. The data indicate that it should be possible to increase nonvolatile content from 17 percent in the 1:1 ratio, using RS ½-second type with the standard solvent, to 29.5 percent in the 1:2 ratio, using 30-35 centipoise type with the high-solvency formula. This is an increase of 73.5 percent in nonvolatile content. Similarly, there was an increase from 17 to 36.5 percent when a hot-spray application was employed. This amounted to an increase of 114 percent in nonvolatile content at spraying viscosity. Pigmentation would increase these gains somewhat, depending upon the pigment employed.

INFRARED RADIANT HEAT BAKING OF ENAMELS. R. C. Ernst and E. F. Schumacher. Ind. Eng. Chem. *36*, 1132-37 (Dec. 1944). Comparison between the drying behavior of enamels baked in radiant heat and convection ovens at equal panel temperatures showed no significant differences. Absorptivities were determined for black, green, red, yellow and white gloss enamels. An analysis was made of the distribution of energy in heating these enamels with radiant heat. The influence of convection currents and thermal conduction on radiant heat baking is discussed. The influence of the percentage of polymerizing material in a series of film-forming compositions upon the rate of hardening when baked with radiant heat was determined. The experimental results illustrate the adaptability of polymerizing coatings to the high-temperature short-schedule baking conditions attainable with radiant heat lamps.

U. S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each

PROTEIN PLASTIC. L. A. Watt (to Monsanto Chemical Co.). U.S. 2,365,671, Dec. 26. A composition comprising a thermosetting phenol-formaldehyde resin, a filler, and the reaction product of a protein and a polyvalent metal hydroxide.

POLYMERS. C. J. Mighton (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,365,717, Dec. 26. A polymer consisting of the reaction product of butadiene with a mononitro alkanol diester of an alpha ethylenically unsaturated alpha, beta dicarboxylic acid.

MOLDING COMPOUND. C. R. Gleason and R. M. Small (to Sealkote Corp.). U.S. 2,365,753, Dec. 26. A molding compound is prepared by beating a fibrous filler in water, removing excess water, heating and kneading, adding a hot thermosetting resin, mixing, and finally drying and pulverizing.

DIAL. H. E. Chapman. U.S. 2,365,864, Dec. 26. An illuminated watch dial comprised of a light distributing plastic face.

HELIX. A. W. Hanson (to Dow Chemical Co.). U.S. 2,365,952, Dec. 26. A machine for continuously forming a flexible helicoidal structure from a plastic tape.

ION EXCHANGE AGENT. G. F. D'Alelio (to General Electric Co.). U.S. 2,366,007, Dec. 26. A cation exchange agent comprising a water-insoluble sulfonated polymerizate of a polyvinyl aryl compound together with a monovinyl aryl compound.

ION EXCHANGE AGENT. G. F. D'Alelio (to General Electric Co.). U.S. 2,366,008, Dec. 26. An anion exchange agent comprising a water-insoluble aminated polymerizate of a polyvinyl aryl compound together with a monovinyl aryl compound.

ASBESTOS COMPOSITE. H. W. Hall. U.S. 2,366,025, Dec. 26. A mixture of urea-formaldehyde glue, a catalyst and asbestos is applied to a lignocellulosic substance and cured under pressure.

ADHESIVE. C. R. Payne and R. B. Seymour (to Atlas Mineral Products Co.). U.S. 2,366,049, Dec. 26. An alkali-acid-proof adhesive is prepared by dissolving polyvinyl butyral in furfuryl alcohol and polymerizing the furfuryl alcohol by adding an organic acid.

RESIN. J. B. Rust (to Montclair Research Corp.). U.S. 2,366,129, Dec. 26. A water-soluble resin is prepared by heating tetra-ethylenepentamine with boric acid at 180 to 220°C.

JOINING MEANS. H. J. Luth and H. B. Scheidemantel (to Brunswick-Balke-Collender Co.). U.S. 2,366,274, Jan. 2. Sheets of paper laminated with phenol-formaldehyde resin are joined by drilling holes through both sheets, filling the holes with a thermoplastic composition comprising a cellulose derivative, fuzing while closing both ends of the hole and then allowing to cool so that a rivet-like shape is formed.

POLYVINYL HALIDES. C. H. Alexander and H. Tucker (to B. F. Goodrich Co.). U.S. 2,366,306, Jan. 2. A vinyl halide is polymerized in the presence of a diacyl peroxide derived from a fatty acid containing between 4 and 10 carbon atoms.

COATING. G. Lindh (to Udylite Corp.). U.S. 2,366,414, Jan. 2. A chemically-resistant, wear-resistant, and highly adhering coating comprising a mixture of a polymethacrylic ester and a copolymer of vinylidene chloride and vinyl chloride.

MOLDING. H. F. Macmillin (to Hydraulic Development Corp.). U.S. 2,366,417, Jan. 2. An apparatus for continuous extrusion molding of plastic materials.

MOLDING COMPOUND. F. Ringer. U.S. 2,366,425, Jan. 2. A moldable composition is obtained from pentosan containing farm products by cooking in a dilute mineral acid, applying pressure and cooking further, adding alpha or beta naphthol, aniline, or a natural resin or resin acid, and subjecting the resulting mixture to condensation, evaporation, washing and drying.

COUPLING. J. R. Dorman. U.S. 2,366,444, Jan. 2. A coupling for plastic tubing and the means for applying this tubing.

RESIN. G. F. D'Alelio (to General Electric Co.). U.S. 2,366,494, Jan. 2. The reaction product of a partial condensate of urea, formaldehyde and benzyl sulfonamide with chlorinated acetamide.

RESIN. G. F. D'Alelio (to General Electric Co.). U.S. 2,366,495, Jan. 2. A molecularly oriented copolymer which exhibits a crystalline x-ray diffraction pattern, comprising the cold-drawn product of the polymerization of acrylonitrile with an itaconic acid ester.

COMPOSITE STRUCTURE. P. J. Gaylor (to Standard Oil Development Co.). U.S. 2,366,514, Jan. 2. A thick section of a solid organic plastic is protected by a thin film of glass cemented to the surface.

COATING. H. T. Galley (to Eastman Kodak Co.). U.S. 2,366,723, Jan. 9. A photographic paper is waterproofed with a melt-coating consisting of cellulose acetate butyrate and a plasticizer, followed by a baryta coating.

PLASTICS. B. Geller. U.S. 2,366,781, Jan. 9. A ligno-cellulose material is dispersed in an inert bath and heated. Urea and acetic and sulfuric acids are then added, together with lignin resin, and the resulting product removed from bath.

PLASTIC MATERIALS. W. Horback and W. D. Paist (to Celanese Corp. of America). U.S. 2,366,788, Jan. 9. Decorative effects are obtained on plastic materials containing cellulose esters by means of the action of an etching bath of sulfuric acid.

RESINS. T. Smedslund (to J. Bjorksten). U.S. 2,366,813, Jan. 9. A resin is prepared by chlorinating a vapor phase cracked petroleum product in the presence of magnesium and then polymerizing the chlorination product.

NITROCELLULOSE. R. L. Stern (to Hercules Powder Co., Inc.). U.S. 2,366,880, Jan. 9. Nitrocellulose is stabilized by boiling first in an alkaline solution and then in water, filtering, and washing with an aqueous slurry of nitrocellulose.

INSULATION. J. Veit. U.S. 2,366,944, Jan. 9. A method for coating wire with molten, distinctively colored thermoplastic material.

MOLDING. H. Finzel and H. Maykemper (to Clearing Machine Corp.).

(Please turn to next page)

U.S. 2,367,015, Jan. 9. A device for shaping articles by plastic deformation.

CLOSURE. A. M. McConnell and W. E. Braham (to Lockheed Aircraft Corp.). U.S. 2,367,035, Jan. 9. A transparent closure consisting of a synthetic resin for the cockpit of an airplane.

MICA SHEET. F. G. Pellett (to General Electric Co.). U.S. 2,367,047, Jan. 9. A composite sheet of shellac-bonded mica coated with methyl-methacrylate polymer.

POLYETHYLENE. E. L. Martin. U.S. 2,367,173, Jan. 9. Films, filaments, etc., are prepared from polyethylene by extruding it in the absence of oxygen at a temperature at least 85° above the melting point of the polymer.

SYNTHETIC RESINS. A. C. Byrns (to Union Oil Co. of Calif.). U.S. 2,367,-183, Jan. 16. Resins are produced by heating olefin-free alkylated aromatic hydrocarbon mixtures of alkyl substituted monocyclic and polycyclic aromatics with formaldehyde in the presence of zinc chloride dissolved in acetic acid, dissolving the mixtures in a low boiling paraffin hydrocarbon, separating the soluble and insoluble phases, and finally removing the solvent.

INJECTION MOLD. W. P. Cousino (to Chrysler Corp.). U.S. 2,367,204, Jan. 16. An apparatus for the injection molding of plastic materials.

PHENOLIC RESINS. R. P. Lutz (to Western Electric Co., Inc.). U.S. 2,367,-296, Jan. 16. An x-ray shield containing resinous material and metallic particles and carbon black as a dispersing agent for the metallic particles.

FURANE RESINS. E. A. Reineck (to Kewaunee Mfg. Co.). U.S. 2,367,312, Jan. 16. An uncured resin dispersion comprising furfuraldehyde and furfuralcohol, containing sufficient catalyst to effect a cure when heated and also containing as much water as it will absorb.

SEALING COMPOUND. L. L. Rector and C. L. Cron. U.S. 2,367,375, Jan. 16. A sealing compound containing a cellulose ether, a solvent, and an excess of plasticizer of limited solubility in the cellulose ether which forms a film when the solvent is finally evaporated.

COATING. L. L. Rector and C. L. Cron. U.S. 2,367,376, Jan. 16. A coating comprising a cellulose derivative dissolved in a series of solvents and blown castor oil which has limited solubility in the cellulose derivative.

EXTRUSION MACHINE. F. T. Griffiths (to W. T. Henley's Telegraph Works Co., Ltd.). U.S. 2,367,394, Jan. 16. An extrusion machine for molding plastic material.

MOLDING COMPOUND. F. J. Myers (to Resinous Products and Chemical Co.). U.S. 2,367,423, Jan. 16. A heat-curable, moldable, extrudable, calenderable, plastic composition is prepared by mixing an insoluble infusible reaction product of an alkyd resin and the condensate of formaldehyde, an alcohol, and a carbamide or an amino-triazine with a condensate of formaldehyde, an alcohol and a carbamide or an amino-triazine with a soluble alkyd resin.

MOLDING. H. H. West. U.S. 2,367,-451, Jan. 16. A heater to be used in conjunction with the extruding nozzle of a plastic molding machine.

RESIN. L. H. Bock and A. L. Houk (to Rohm and Haas Co.). U.S. 2,367,455, Jan. 16. A resin is prepared by reacting formaldehyde and aminocyanoacetamide.

POLYAMIDES. P. Möller and H. J. Nicolai (to Alien Property Custodian). U.S. 2,367,469, Jan. 16. A water-soluble polyamide is prepared by condensing hexamethylene-diamine adipate with epsilon-aminocaproic acid hydrochloride for 20 hours in the absence of air.

SHOE SOLES. J. Burger. U.S. 2,367,-481, Jan. 16. A plastic shoe sole.

VINYL COPOLYMERS. L. E. Cheyney (to Wingfoot Corp.). U. S. 2,367,483, Jan. 16. A copolymer composed of vinyl chloride and vinylidene chloride is stabilized with dicyandiamide.

CELLULOSE DERIVATIVES. C. R. Fordyce and G. J. Clarke (to Eastman Kodak Co.). U.S. 2,367,493, Jan. 16. Filaments of cellulose acetate butyrate are prepared by extruding a solution in propylene chloride and ethylene chloride through a bath of toluene and drying.

CELLULOSE DERIVATIVES. W. F. Hunter, Jr., H. A. Tanner and R. E. Gillmor (to Eastman Kodak Co.). U.S. 2,-367,503, Jan. 16. Film-forming cellulose derivative compositions suitable for uniaxial photographic film bases.

CELLULOSE NITRATE. W. E. Sillick (to Eastman Kodak Co.). U.S. 2,367,533, Jan. 16. Cellulose nitrate is prepared by nitrating, centrifuging, sousing in a mixture of nitric and sulfuric acids, separating and passing through a series of baths of progressively decreasing concentrations until the wash is neutral.

COVERING STRUCTURE. D. H. Spitzli (to Congoleum-Nairn, Inc.). U.S. 2,367,536, Jan. 16. A covering structure comprising a body portion, a layer of plastic material, a layer of cement and a thin, flexible, sheet-like barrier, all bonded to form an integral structure.

ADHESIVES. J. Teppema and J. F. Manning (to B. B. Chemical Co.). U.S. 2,367,629, Jan. 16. A liquid adhesive composition comprising butadiene-acrylonitrile and vinyl chloride-acetate copolymers.

DOME. E. L. Helwig (to Rohm and Haas Co.). U.S. 2,367,642, Jan. 16. Thermoplastic domes are prepared by heating sheets of organic plastic material, clamping the edges to a hollow pressure chamber, and deforming by a vacuum.

PLASTIC CONDUIT. G. S. Hendrie (to Detroit Macoid Corp.). U.S. 2,367,-643, Jan. 16. A fluid-tight flexible conduit composed of thermoplastic material.

PHOTOPOLYMERIZATION. C. L. Agre (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,367,660-1, Jan. 23. Polymers or copolymers of vinyl compounds, with each other or with an alpha carbonyl alcohol, are prepared by irradiating with light of wave-lengths of 1800 to 7000 Angstroms in the presence of a vicinal polyketaldonyl compound as a catalyst.

CEMENTING PROCESS. R. E. Christ (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,367,670, Jan. 23. Polymethyl methacrylate surfaces are bonded by interposing fluid polymerizable methyl methacrylate containing benzoin between them and irradiating.

PUMP. F. M. Roddy. U.S. 2,367,-691, Jan. 23. A positive displacement pump for pumping plastic materials.

BONDING. G. Lindh and W. M. Philips, Jr. (to Udylite Corp.). U.S. 2,367,725, Jan. 23. Sheets of thermoplastic material are joined by directing a stream of hot gas against both surfaces until they are fused.

DENTURE. E. H. Gale. U.S. 2,367,-767, Jan. 23. A denture is prepared by wetting an acrylic resin with carbon tetrachloride and heating under pressure in contact with a plaster mold.

COMPOSITE. N. J. Rakas (to Chrysler Corp.). U.S. 2,367,800, Jan. 23. A plastic article containing a metal insert.

ARCH SUPPORT. W. M. Scholl. U.S. 2,367,804, Jan. 23. A thermoplastic arch support and means for fitting it to the individual foot.

POLYSTYRENE. R. B. Semple (to Monsanto Chemical Co.). U.S. 2,367,805, Jan. 23. Styrene is polymerized by heating in the presence of a hydroperoxide.

STYRENE POLYMERS. V. H. Turkington and L. R. Whiting (to Bakelite Corp.). U.S. 2,367,810, Jan. 23. Styrene and its derivatives are polymerized by heating with a two-component catalyst consisting of an oxy-compound of boron and a diester or a dibasic acid.

BOOKS AND BOOKLETS

Write directly to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent post-paid at the publishers' advertised prices.

Chemistry Made Easy, 4 Vols.

by Cornelia T. Snell and Foster Dee Snell

Published by D. Van Nostrand Co., Inc., 250 4th Ave., New York, 1943

Price $7.95 **1214 pages**

The authors, experienced in teaching and working in chemistry, have prepared these books for the reader who must study the subject without a teacher or laboratory. The basic fundamentals of chemistry are explained in simple terms in Volume One. The elements and compounds of inorganic chemistry are described in Volume Two, and the organic compounds in Volume Three. Volume Four is a reference book on the composition, properties and uses of commercial chemical products, formerly published separately under the title "Chemicals of Commerce." Questions and problems at the end of each chapter provide the student with a useful means of checking his grasp of the subject matter. G.M.K.

Formaldehyde

by J. Frederic Walker

Reinhold Publishing Corp., 330 W. 42nd St., New York, 1944

Price $5.50 **397 pages**

This book is an admirable addition to the well-known American Chemical Society Monograph Series. Its significance to chemists and executives in the plastics industry is indicated by the fact that 78 percent of the formaldehyde produced during the years 1939-1942 was consumed in the manufacture of resins. Another interesting observation is that the production of formaldehyde increased from 180 million pounds in 1940 to approximately 500 million pounds in 1943. Although much of this expansion was to take care of military requirements, it nevertheless presents a plant capacity comparable to that of styrene as a potential source of raw material for postwar plastics. Thus it is evident that a careful study of formaldehyde chemistry should prove worth while for those concerned with the development and with the manufacture of synthetic resins.

The author first discusses the commercial and laboratory methods of producing formaldehyde. The physical and thermodynamic properties of the simple monomer, polymers and solutions are reviewed in the next six chapters. Eight chapters are devoted to the chemical properties of formaldehyde and its reactions with various types of inorganic and organic chemicals. A chapter on hexamethylenetetramine and two each on analytical methods and uses conclude the monograph. Ample references to the literature are given in the treatment of all of these subjects. G.M.K.

Plastics — Scientific and Technological

by H. Ronald Fleck

Published by Temple Press Ltd., London, and Chemical Publishing Co., Inc., 26 Court St., Brooklyn, 1944

Price $6.50 **325 pages**

This book is unusual in that the author avowedly prepared it for chemists in the industry and those whose professional duties necessitate a knowledge of the science of plastics. He deprecates the exuberant publicity given to plastics merely because of their novelty and the appeal of the pseudo-scientific to the imaginations of unscientific lay reporters.

His critical survey of the literature and correlation of scattered data is written in an instructive and interesting style. It includes discussions of the chemistry and manufacture of plastics, testing methods and properties, special applications such as adhesives, fibers and protective coatings, and the chemical analysis of raw materials. The processes of mold manufacture and molding are only briefly described. Many diagrams and tables are inserted in the text to assist the reader in the development of the technical aspects of plastics. G.M.K.

Sampling Inspection Tables

by Harold F. Dodge and Harry G. Romig

Published by John Wiley and Sons, Inc., 601 W. 26th St., New York, 1944

Price $1.50 **106 pages**

The tables presented and discussed in this book were developed originally for use in the inspection of equipment manufactured by the Bell Telephone System and have been widely used to control wartime production. Their application has contributed to reduction in inspection costs and improvement in quality control of raw materials, piece parts and finished assemblies. G.M.K.

★ BAKELITE CORP., NEW YORK, N. Y., has released two brochures — "Bakelite Cold-setting Phenolic Resin Glue XC-17613" and "Bakelite Urea Resin Glues."

The first booklet, written to acquaint plywood and furniture manufacturers with the properties of this newest phenolic glue, also contains instructions on its use. The latter presents a description of the advantages to be found in a use of urea resin glues for plywood and densified wood and devotes a chapter to the postwar future of these resins.

★ HERCULES POWDER CO., INC., Wilmington, Del., has compiled a series of its advertisements based on the work the company has been doing in supplying war matériel. "Labors of War for Peace" presents a picture of "Hercules Land" and its postwar potentials. Colorfully illustrated, the brochure delineates products developed to aid in the war effort and suggests postwar applications which might result as an outgrowth of these developments.

★ LUMINESCENT PIGMENTS, marketed under the trade name of Violite, are the subject of a booklet offered by Rhode Island Laboratories, Inc., West Warwick, R. I. The brochure contains many illustrations of the varied industries in which these pigments may be applied.

★ DESIGNING WITH INDERON IS the subject of an 8-page brochure issued by C-W Plywood Co., Chicago, Ill. Lists of possible uses of Inderon — the trade name of three groups resulting from the infrangible unification of wood veneers and plastic laminates — in many industries are included in addition to data on the three different grades available.

★ AN 86-PAGE ILLUSTRATED manual on electrical insulating materials made and marketed by Mica Insulator Co., Schenectady, N. Y., presents data, tables and values on sheet mica, laminated plastics, varnished cloth, tapes, varnishes, twines and fiberglas.

★ "NEVILLE RESINS AND PLASTICIZERS," recently received from Neville Co., Pittsburgh, Pa., is believed to contain the most complete data on coumarone-indene resins ever published. The 82-page book, under the heading, "Industrial Uses of Neville Resins & Plasticiz-

ers," gives new information on applications of a number of these products. "Neville Products under Development" presents a preview of new and useful products available in sample or semi-commercial quantities. Other major developments in this field are also treated in detail.

★ THE 43RD EDITION OF "HOW to Run a Lathe," has been issued by South Bend Lathe Works, South Bend, Indiana. The book covers operation of lathe units, grinding cutter bits, accurate measurements, plain turning, chuck work, boring, drilling, reaming, tapping, etc. Copies are available at 25 cents, paper bound and 75 cents leatherette bound. A technical booklet is prepared by the same company.

★ NATURAL RESOURCES OF THE Pacific Northwest offer many attractions for potential plastics manufacturers, according to a preliminary report on the plastics industry released today by the Bonneville Power administration. Prepared by Arthur J. Norton, consulting chemist of Seattle, Wash., in collaboration with BPA's industrial and resources development staff as a part of the Bonneville marketing program, a limited number of copies of the report will be available to persons immediately concerned with Northwest industrial development and particularly those interested in the establishment of plastics manufacture in this region. Copies may be obtained from Bonneville's Div. of Industrial and Resources Development, Guardian Bldg., Portland, Oregon.

Significant factors which indicate possible development of a well-rounded plastics industry in the Pacific Northwest include the region's tremendous low-cost hydroelectric power resources, adequate natural resources including wood, coal, petroleum, vegetable and animal products, and minerals; and favorable domestic and foreign market potentialities. Summarizing the marketing prospects, the report states that while the population of the West Coast's trading area is only eight to ten percent of the population of the United States, local markets for plastic materials are considerably higher than this percentage due to the concentration of plywood and aircraft industries in this section of the country.

Pacific Northwest plywood industries now consume about 10 million pounds of phenolic resins annually in the manufacture of various grades of plywood. With prices adjusted to postwar levels and without restrictions on critical materials, this consumption should reach 40 million pounds a year and could perhaps approach 80 million pounds with present hot-press equipment.

Because of the Northwest's timber resources, bonded wood can be sold profitably in Eastern markets, and as a result there is a large, ready demand for the resins, plastics and chemicals used in this work. A Pacific Northwest chemical industry would lower production costs and could extend the field of consumption many times, the report states.

Other branches of the plastics industry which could be developed to advantage in the Pacific Northwest include the manufacture of furniture and other large objects by preforming of resin-impregnated pulp into large shapes; wood treatment materials, including paints, coating resins and lacquers; cellulose derivatives, including plastics, fibers and films; synthetic rubber and natural rubber processing; synthetic fibers; and textiles, which should be of intense importance in the over-all industrial growth of the Pacific Northwest.

The report includes tables and maps giving the sources of raw materials for the manufacture of plastics; location of plywood plants, molders, laminators and fabricators of plastic materials throughout the United States; location of Pacific Northwest manufacturers and consumers of plastic materials, and potential markets for plastic products in selected consuming industries.

Because the plastics industry is essentially a branch of the chemical industry, its development on a major scale will be handicapped until the Pacific Northwest develops a more diversified group of local chemical industries. Therefore, the report urges stimulation of research on basic problems underlying establishment of industries in the chemical and plastics fields.

★ A TECHNICAL BULLETIN ON "Cordo-Tack Pressure-Sensitive Adhesives," issued by Cordo Chemical Corp., lists the properties, applications, uses and limitations of these materials. Presented as solutions in organic solvents, the adhesives exhibit strong tack to most materials and, to many others, a continued tack that permits resealing of the adhesive after separation.

★ PLASTIC DIE AND TOOL Corp., Los Angeles, Calif., presents in "Plastic Molded Products," an outline of the work it is accomplishing in the molding of war and postwar articles.

★ CONTINENTAL MACHINES, Inc., Minneapolis, Minn., has made available "Quality Control," a handbook on scientific inspection. Over 200 photographs, diagrams, charts and tables explain the subject in an informative manner, highlighting the information with examples of how to use precision measuring instruments. Sixty-four key questions and answers serve as a check and a test of knowledge gained in studying this handbook.

★ ESSENTIAL INFORMATION ON commercially available plasticizers is contained in a booklet, "Plasticizers," Form 5882, released by Carbide and Carbon Chemicals Corp., New York, N. Y. Included in the brochure are names, formulas, physical properties and specifications, charts showing the compatibilities of the plasticizers when used with commercial resins and data on their performance.

★ "IT'S POSITIVELY RIGHT IN Bruning Black and White" deals with the BW process for making black and white prints, as distinguished from blueprints, introduced by Charles Bruning Co., Inc., Chicago, Ill. The company claims that this method can save untold time and money for the businesses and industries which use it.

★ PRODUCT DESIGNERS, CHIcago, Ill., have issued an illustrated booklet on "Design for Profit," to those manufacturers interested in re-designing present products or developing postwar products.

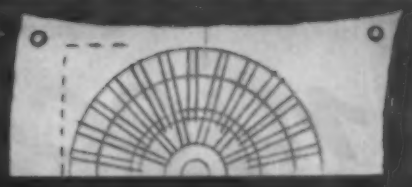
★ TWO PAMPHLETS CONCERNing their Flex-O-Timer and fulscope time schedule controller have been released by Taylor Instrument Companies, Rochester, N. Y. Descriptions of the systems and advantages to be obtained from their use are contained in each booklet.

★ THREE REASONS WHY THE Lester is rated among America's best injection machines are given in "Shaping the Things of Tomorrow," a recent publication of Lester-Phoenix Inc., Cleveland, Ohio, which illustrates the company's complete line of high-production injection machines.

★ A CATALOG RECEIVED FROM Standard Chemical Co., Akron, Ohio, sales agents for Piccolastic resins, manufactured by Pennsylvania Industrial Chemical Corp., Clairton, Pa., describes the many types and grades of these resins, which are polymers of styrene and its homologues, in a wide range of average molecular weights. Among the many uses suggested for the resins are: as adhesives, wire and cable insulation, laminating agents, printing inks, phonograph records, plastic cements and plywood glue.

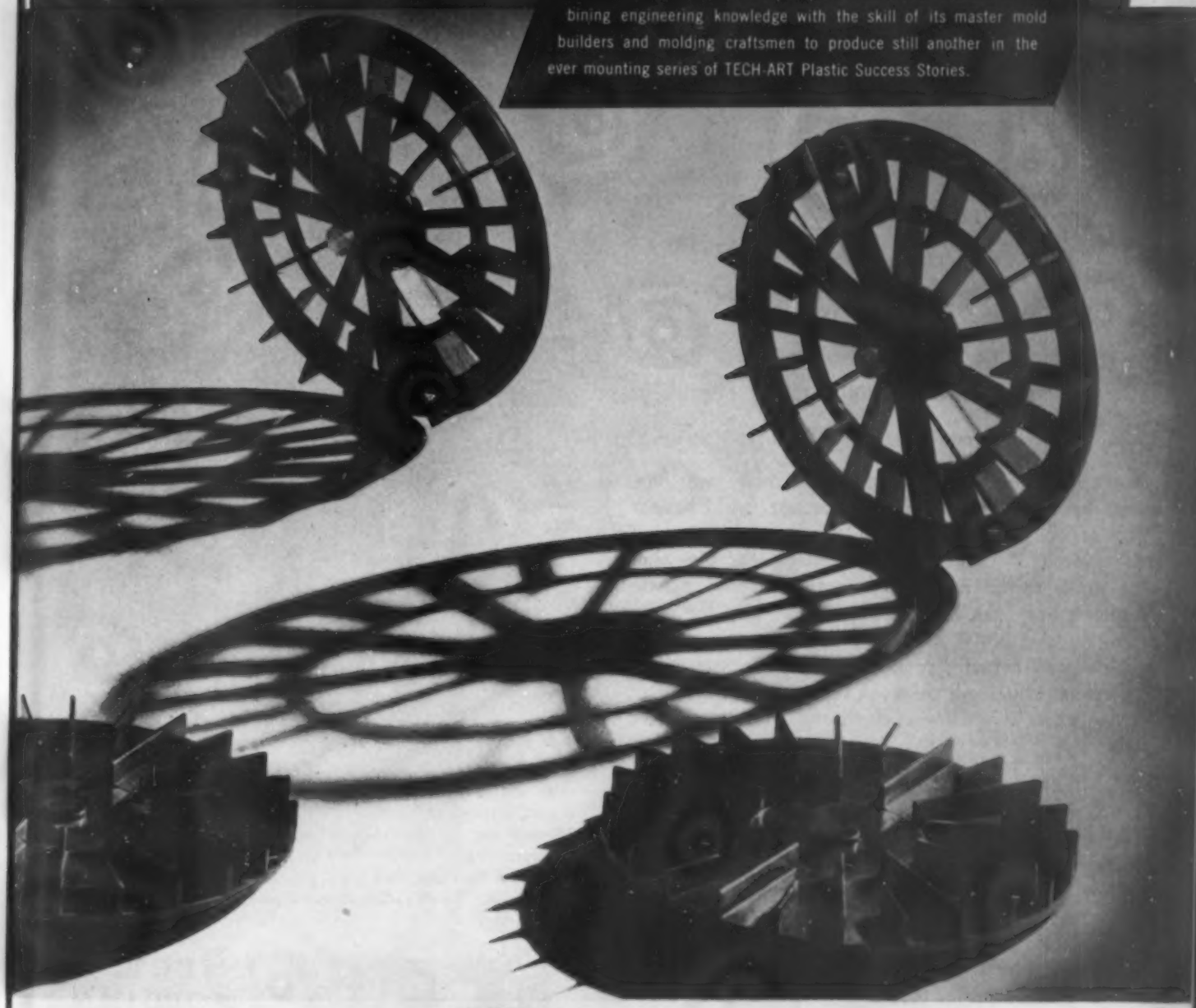
REVOLUTION-ARY *Ideas . . . Molded in* PLASTICS

Revolutionary in their functional use as well as in their concept have been many of the products molded by TECH-ART. Never in today's practice need plastics be considered a media for products of static use only. Instead, more and more products having dynamic functions are being engineered and produced under the trained minds and skilled hands of TECH-ART's engineers and craftsmen. TECH-ART's vast facilities include every type of compression and compression-transfer molding equipment, as well as a large battery of injection molding units. Add to this TECH-ART's broad experience in product engineering and development and you have the best assurance that your product, too, in the hands of TECH-ART, will become another Plastic Success Story.



Another Plastic Success Story

The Permutit Company brought these impulse and impeller wheels to TECH-ART to mold. To revolve at speeds as high as 3200 r.p.m., their thin fins had to be extremely strong. Precision molding and the use of materials that would not warp was essential if the delicate balance of rotary action was to be maintained. The fact that TECH-ART has delivered many thousands of these finely balanced parts to this leading manufacturer of chemical measuring instruments and equipment is a splendid example of the art of combining engineering knowledge with the skill of its master mold builders and molding craftsmen to produce still another in the ever mounting series of TECH-ART Plastic Success Stories.



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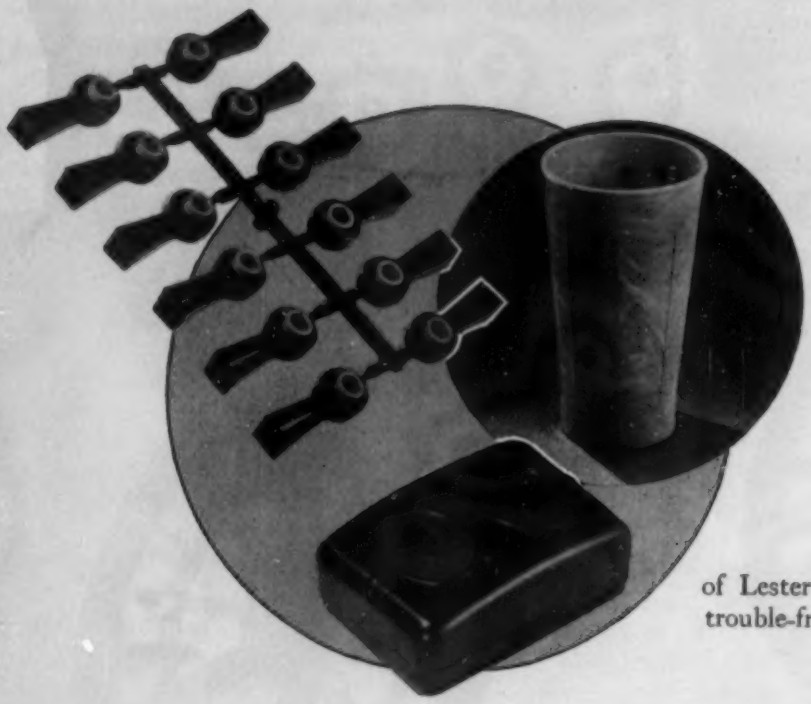
SUCCESSORS TO BOONTON RUBBER MANUFACTURING COMPANY

Injection MOLDING

NUMBER FOUR OF A SERIES

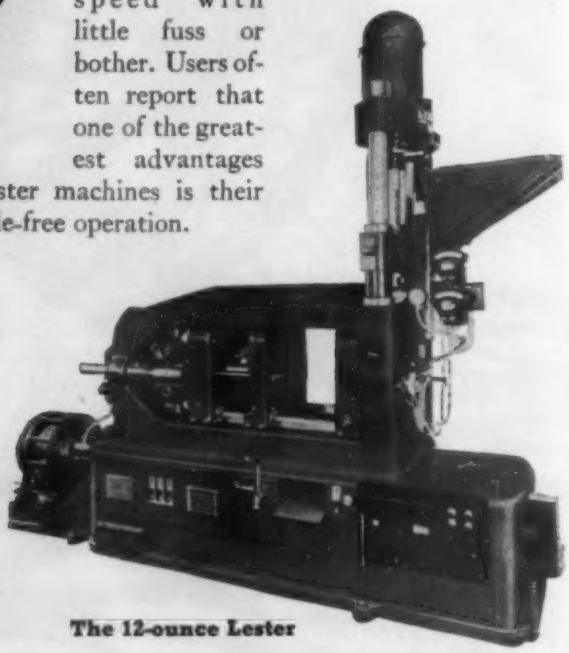


THE Sunday supplement artists who are now designing the super-streamlined postwar world have a habit of looking to plastics for "the stuff that dreams are made of." American manufacturers, the men who make things instead of dreams, choose plastic materials not only for eye appeal but also for their strength, durability and ease of fabrication. And molders who actually produce the plastic parts want machinery which will turn out the greatest number of flawless parts at the lowest cost in the shortest possible time.

Shown above are three excellent examples of the use of plastics, three products which in all probability will be made after the war as they were before or during the war. The faucet handles are now being made, 12 per shot, on a 12-ounce Lester in the plant of the Plastic Die and Tool Corporation of Los Angeles, and are being used largely by the Army, Navy and Merchant Marine. Made of cellulose acetate or cellulose acetate butyrate, they incorporate a zinc die-cast insert at the point of maximum wear. A few of these handles have been available for civilian use; doubtless millions will be used in new homes after the war.

The cameo soap box, made of butyrate by the Pyro-Plastics Co. of Westfield, N. J., shows first-rate molding technique. To fill out a thin section of this shape with a virtually invisible weld line opposite the gate, it is necessary to have plenty of effective pressure ***in the die cavity,*** where it really counts. Fig. 3 shows a drink mixer cup, a good instance of deep cavity work.

All of these parts are made on Lester injection molding machines and all are made at high speed with little fuss or bother. Users often report that one of the greatest advantages of Lester machines is their trouble-free operation.



The 12-ounce Lester

Injection Mold Design

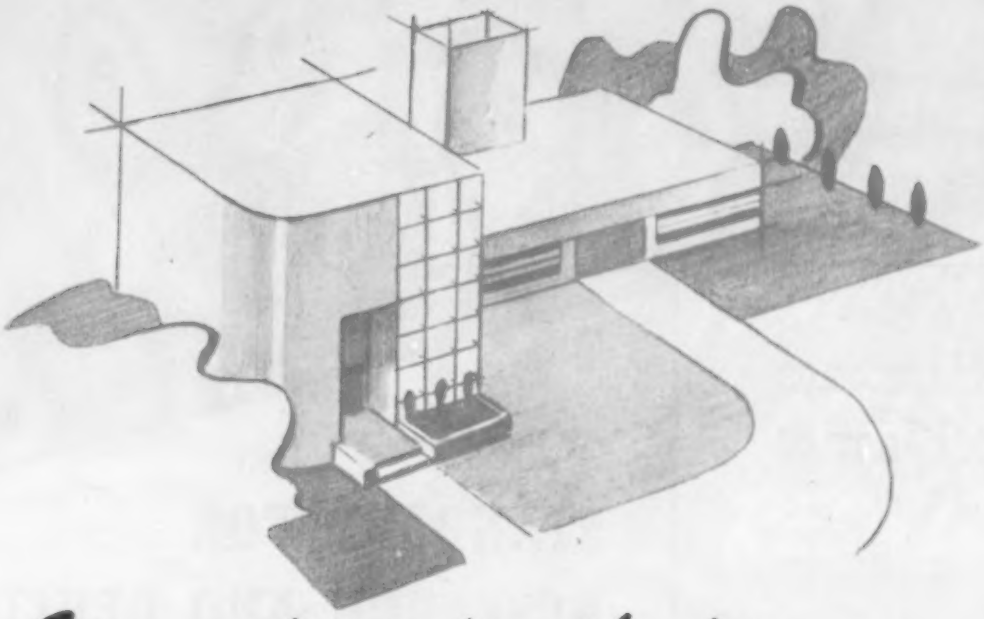
Islyn Thomas, New York plastics consultant, has written two clear and authoritative articles on the subject of injection mold design, planned to bring together the plastics customer, the sales engineer and the mold designer so that they may reach a better understanding of one another's problems. As a service to the industry we have reprinted these and offer them free to the readers of *MODERN PLASTICS*. Send for your copy today.

LESTER INJECTION MOLDING MACHINES

"Shaping the Things of Tomorrow"

National Distributors:

LESTER-PHOENIX, INC., 2711 Church Ave., Cleveland 13, Ohio



Your plans for the future

Plastics coat hook capable of supporting 280-pound weight. Molded by Pyro.

This plastics scoop replaced heavier metal type. Injection molded by Pyro.

If you are designing postwar products NOW, perhaps we can be of help. Our Designing Department can help you shape up those new ideas . . . and possibly contribute some of their own.

We welcome inquiries from manufacturers who are thinking in terms of plastics for all or part of their postwar products. At Pyro your inquiry will receive the personal attention of our executive personnel.

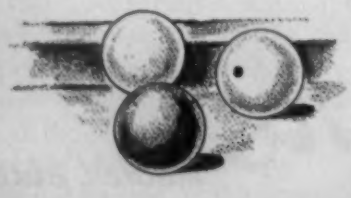
For fine workmanship specify **Pyro** *molded plastics*

THE PYRO PLASTICS COMPANY · WESTFIELD · NEW JERSEY

THE CARVER LABORATORY PRESS

Milestones in Plastics

The shortage of elephant tusks in the late sixties had far-reaching effects. When the dwindling supply of ivory for billiard balls threatened to curtail the popular game, an American manufacturer offered a reward for the discovery of an ivory substitute. The vision and steadfastness of a young printer, working in off-hours, finally led to the discovery of a satisfactory material. This resulted in the commercial introduction of cellulose nitrate plastics and gave the first impetus to plastics in America. The cellulose acetates came later. Through the years research has continued to expand the possibilities of these versatile materials and their development forms one of the most colorful chapters in plastics history.



STANDARD FOR RESEARCH AND DEVELOPMENT

Probably no industry offers greater evidence of the value of laboratory research than the plastics field during the past 15 years. Taking advantage of discoveries during the first half century of development, recent plastics progress has been based on intense, continuous research and experimental work. An essential aid in this development has been the Carver Laboratory Press. This press is standard

- **for making quick and accurate small-scale pressing tests.**
- **for development, research and instruction work.**
- **for testing single cavity molds.**
- **for preparation of samples.**
- **and even for small-scale production.**

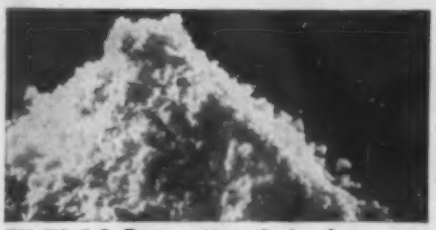
Original in design, the Carver Laboratory Press is small, compact,

- **has a pressing capacity of 20,000 lbs.**
- **weighs only 125 lbs.**
- **operates under self-contained hydraulic unit, giving any precise variations in pressure that may be desired.**
- **large accurate gauge of finest construction is rigidly mounted on base.**
- **special gauges are available for low pressure work.**

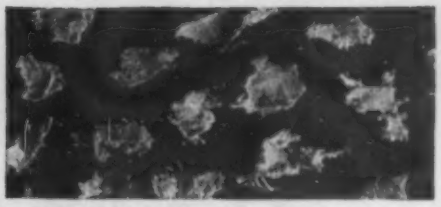
Carver Press accessories include electric and steam hot plates and test cylinders or molds. Also standard interchangeable accessories are available for general research—cage equipment, bearing plates, filtering equipment, etc. The press and certain of the accessories are patented. Send now for latest catalog. PROMPT DELIVERIES FROM STOCK.

FRED S. CARVER
HYDRAULIC EQUIPMENT
343 HUDSON ST., NEW YORK 14

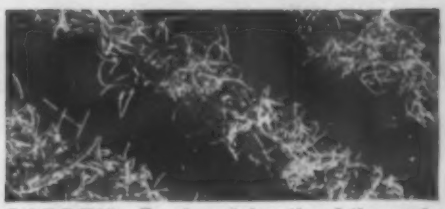
LET'S AIM FOR Maximum FILLER RESULTS!



FILFLOC Pure cotton flock of surpassing cleanliness and uniformity.



FABRIFIL Macerated cotton fabric for extra strength.



CORDFIL Evenly cut lengths of tire cord; for plastics of utmost strength.

For MAXIMUM results, a filler should vary not only with the type of compound, but also with the shape and function of the finished piece.

And little variations often cause a big difference. We have seen the impact strength of a molded item boosted as much as 18% by finding exactly the right cut of filler.

This, of course, requires the cooperation of molder, compound supplier, as well as experience and know-how on the part of the filler manufacturer. Rayco has this experience and know-how, and an eager willingness to put its research facilities to work on the problems of finding for each of your items the filler that's EXACTLY RIGHT.

You use fillers to improve your product. Aim for nothing less than the MAXIMUM improvement! The assistance of Rayco engineers is "Yours for the asking."

CONSIDER PLASTIC HELMET LINER SCRAP

This low-cost molding compound of the phenol-formaldehyde type is quite widely applicable, and effects desirable economy. Prompt shipment from ample stock. Request sample and price.

RAYON PROCESSING CO. of R.I. INC.

60 TREMONT ST., CENTRAL FALLS, RHODE ISLAND

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OBTAIN COMPOUNDS CONTAINING RAYCO FILLERS — FOR GOOD FLOW AND EXTRA STRENGTH

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Come to **dura** with your plastic fabricating problems. As specialists in fabricating, we offer you our experienced personnel and the most modern equipment, especially designed to produce your needs, to help you meet more exacting demands. Now engaged entirely in war production, **dura** looks ahead to serve you in peace time with the same fine plastic fabricating that is meeting war requirements.

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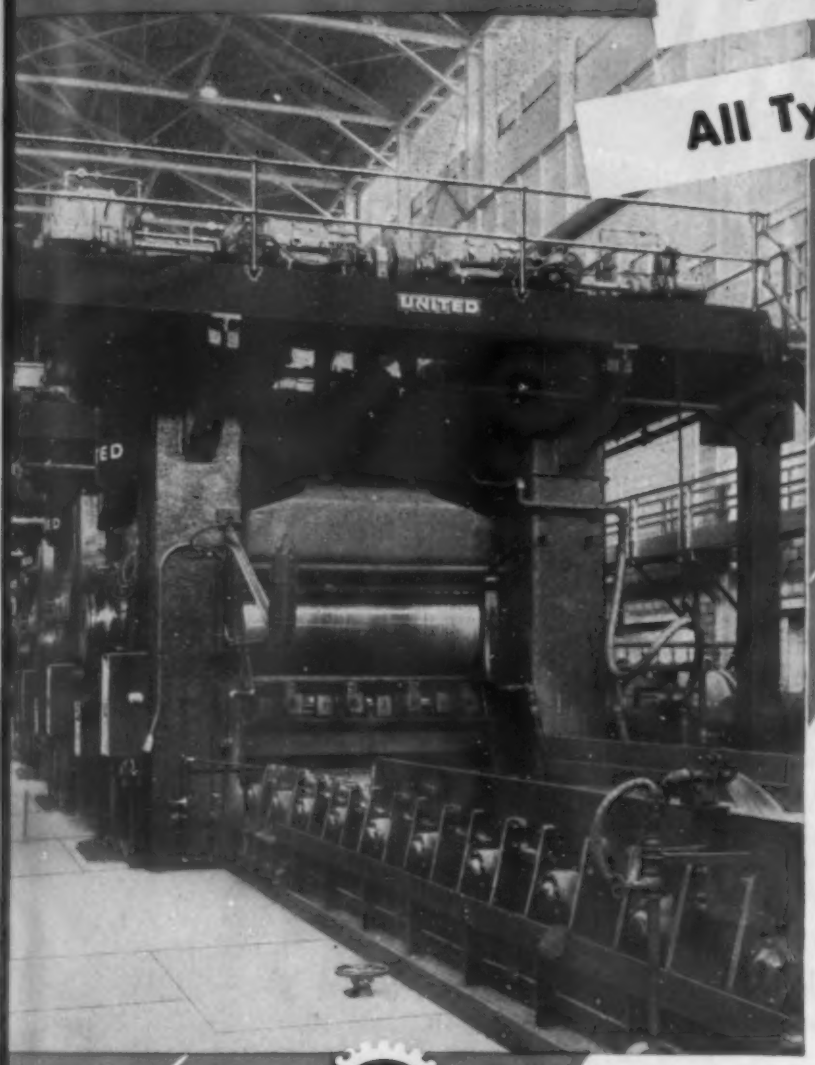
All Types, All Sizes



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In all types: Single Stand, One Way or Reversing, Tandem, Continuous, etc. For Carbon Steel, Alloy Steels, Copper, Brass, Aluminum and other Non-Ferrous Metals.

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Plants at PITTSBURGH, VANDERGRIFT, NEW CASTLE, YOUNGSTOWN, CANTON

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Dominion Engineering Works, Ltd., Montreal, P. Q. Canada

Adamson United Company, Akron, Ohio

The World's Largest Designers and Makers of Rolls and Rolling Mill Equipment

The ONLY Plastic with a continuous re-enforcement of long, resilient ROPE FIBRES

CO-RO-LITE*

a ready-to-mold thermosetting compound that gives great impact, flexural, compressive and tensile strength to bodies of relatively light weight.

Produces Compound Curves, Deep Draws, Angles, Channels and Large Shells with a Minimum of Preparation, "Lay-Up" and Curing Time.

● Quickly and easily cured in high pressure, low pressure, fluid pressure, flash and transfer molds, Co-Ro-Lite provides an interlocking continuity of re-enforcement in any size piece, from the smallest up to the largest that can be accommodated in production-type autoclaves.

It is a production success—proved in hundreds of difficult applications, and backed by more than 40 years of "know how" in selecting, processing and fabricating tough cordage fibres for industrial, marine and farm use.

CO-RO-LITE provides complete physical, chemical, design and pilot-plant service. Tell us your problems. Let our technical experts and industrial designers help you to solve them. Write today for latest handbook giving properties, possibilities and advantages of Co-Ro-Lite.

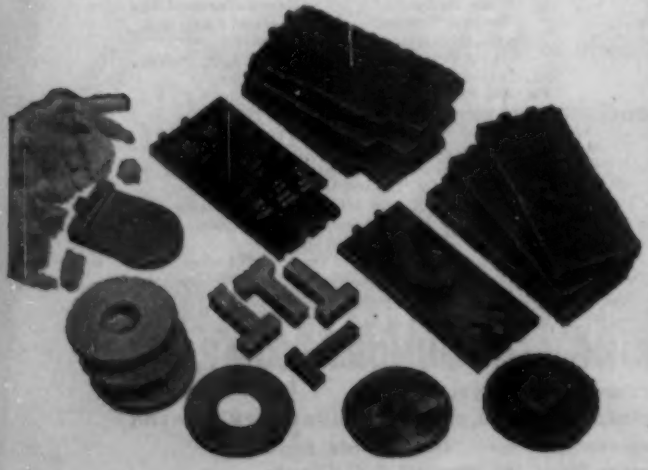
ALLIED PRODUCTS DIVISION

COLUMBIAN ROPE COMPANY

AUBURN, "The Cordage City", NEW YORK

Canadian Licensee, Canadian Bridge Engineering Company Ltd., Box 157, Walkerville, Ontario, Canada

*Process patented; trademark registered in U. S. Pat. Off.



THE PLANT WITH A PERSONALITY

Although we are not Philosophers, we have a philosophy about our business which may have some meaning for you.

It is this: We are a service business, molding plastics for other industries. We therefore try to adapt our plant to those of our customers. We operate as a sort of molding department in conjunction with their regular production.

This means that we have a rather flexible setup.

Underneath, however, you will find a certain rigid structure. Aside from the service angle, we *are* a business. Businesses are supposed to make money. That is why we started ours, anyhow.

We work for a profit honestly and openly. We work for people who expect us to make a profit. They know that they are not getting something for nothing but something for something. Perhaps, they may even be getting a little extra for their money just because the whole transaction is so satisfying both to us and to them.

Perhaps you would be interested in knowing more about our company and what we may be able to do to help you in plastics. We will be glad to tell you if you will let us.

We have a little book with a personality all its own too. We call it "A Ready Reference For Plastics" and it's free for the asking to business men and government employees.

BMCO

ARMY E NAVY

BOONTON MOLDING COMPANY

MOLDERS OF PLASTICS · PHENOLICS · UREAS · THERMO PLASTICS

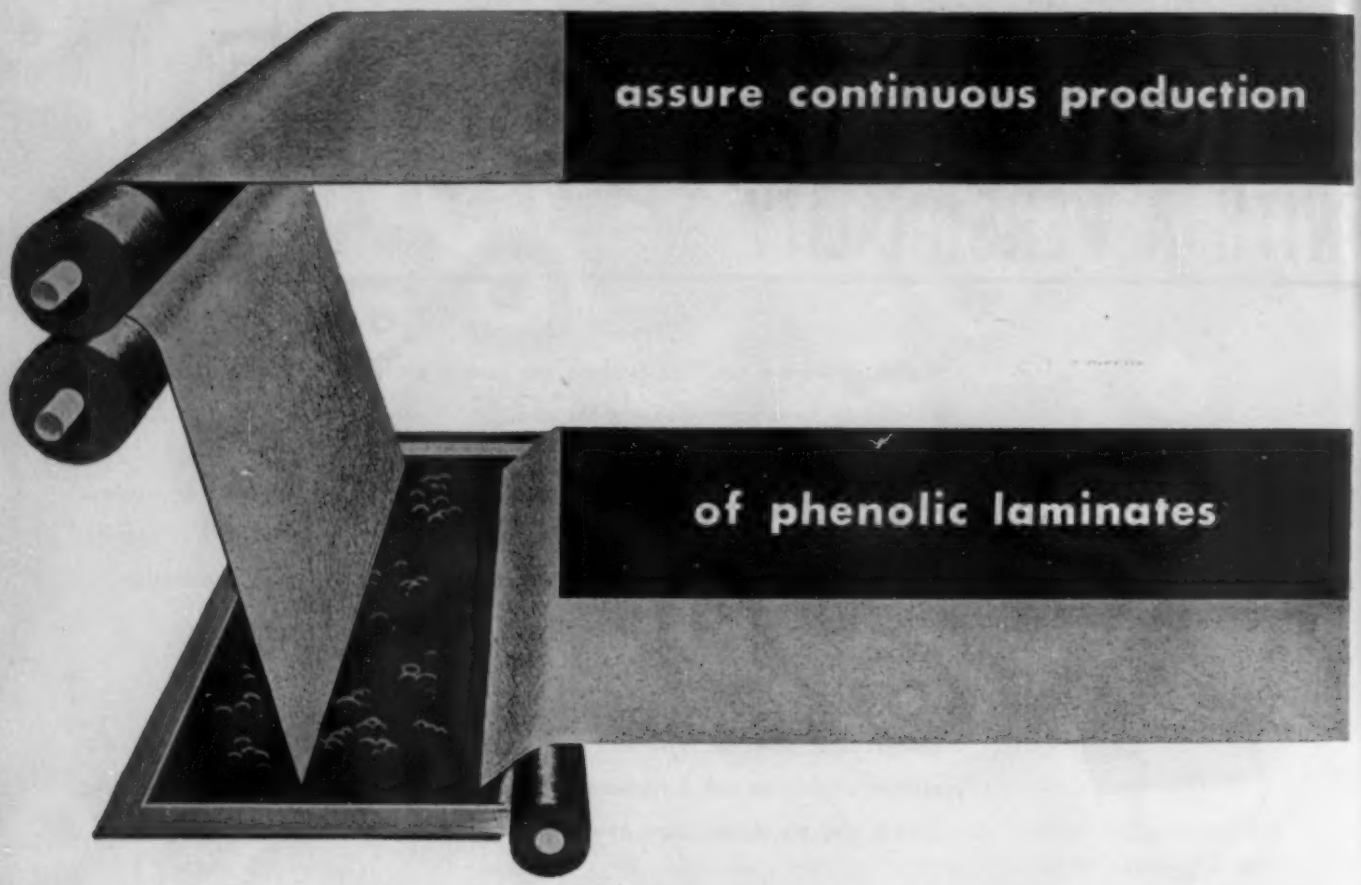
BOONTON · NEW JERSEY · Tel. Boonton 8-2020

NEW YORK OFFICE

Chanin Bldg., 122 East 42nd Street, New York 17, N. Y., MUrray Hill 6-8540

WORLD'S LARGEST PRODUCER OF SYNTHETIC RESINS

RCI



SPECIFY **No. 5012 PLYOPHEN**

If shortage of cresol laminating varnishes is giving you production headaches, switch to No. 5012 Plyophen—a general purpose phenol-base varnish. Produces paper or canvas laminates having both excellent electrical and mechanical properties.

The superior flow characteristics of No. 5012 make it ideal for molded laminates . . . perfectly adapted for NEMA laminate grades X, XX, XXX, C, etc., and corresponding grades required in Army-Navy Specifications. Consider the low cost and quality performance of No. 5012 Plyophen for postwar applications. Write to the Sales Department in Detroit for information.

ARMY E NAVY

REICHHOLD CHEMICALS, INC.

General Offices and Main Plant, Detroit 20, Michigan

Other Plants: Brooklyn, New York • Elizabeth, New Jersey • South San Francisco, California • Tuscaloosa, Alabama • Liverpool, England • Sydney, Australia

SYNTHETIC RESINS • CHEMICAL COLORS • INDUSTRIAL PLASTICS • INDUSTRIAL CHEMICALS

A NEW *PLANETARY SYSTEM*... REVOLVING AROUND THE SOY BEAN

Blaw-Knox offers a complete service to the chemical and process industries. This includes everything from building pilot plants to producing equipment for full-scale production.

For the soy bean industry—as an example—Blaw-Knox has developed improved techniques and specially designed equipment. Blaw-Knox experience and creativeness, its engineering background, its complete facilities, are the basis for a reasonable assumption that Blaw-Knox can be of value to you if your business comes within its scope.

One way for you to find out how and to what extent Blaw-Knox can serve you, is to give us an opportunity for a mutual discussion. Out of that may come some important results.

BLAW-KNOX COMPANY

A PACEMAKER FOR AMERICAN INITIATIVE AND INGENUITY

2081 FARMERS BANK BLDG.
PITTSBURGH, PA.

Five Blaw-Knox Plants have been awarded the Army-Navy "E" for war-production excellence

LEWIS FOUNDRY & MACHINE DIVISION,
Rolls and Rolling Mill Machinery

POWER PIPING DIVISION,
Prefabricated Piping Systems

COLUMBUS DIVISION,
Ordnance Matériel

SPECIAL ORDNANCE DIVISION,
Bofors Anti-Aircraft Gun Mounts and Mechanisms

BLAW-KNOX DIVISION,
Chemical & Process Plants & Equipment, Construction Equipment, Steel Plant Equipment, Radio & Transmission Towers. . General Industrial Products

PITTSBURGH ROLLS DIVISION,
Rolls for Steel and Non-Ferrous Rolling Mills

UNION STEEL CASTINGS DIVISION,
Steel and Alloy Castings

NATIONAL ALLOY STEEL DIVISION,
Heat and Corrosion-Resistant Alloy Castings

MARTINS FERRY DIVISION,
Bofors Anti-Aircraft Gun Mounts

BLAW-KNOX SPRINKLER DIVISION,
Automatic Sprinklers and Deluge Systems

A FEW VICTORY PRODUCTS

ANTI-AIRCRAFT GUN MOUNTS · GUN SLIDES · LANDING BARGES · POWDER PLANTS
PIPING FOR NAVAL VESSELS · SYNTHETIC RUBBER PLANTS
CAST ARMOR FOR TANKS & NAVAL CONSTRUCTION · CHEMICAL PLANTS

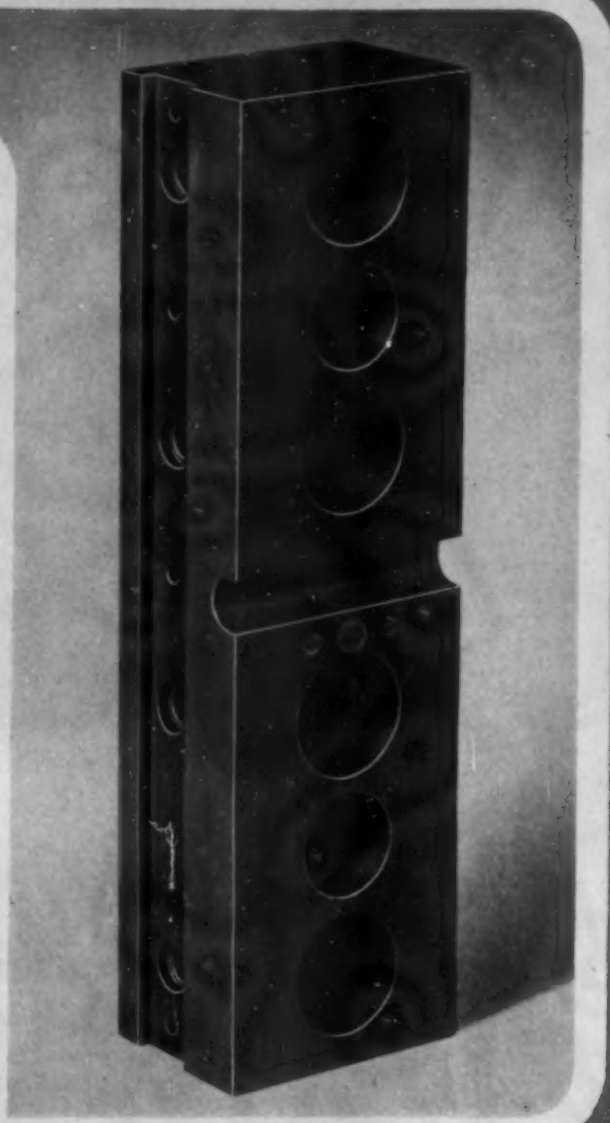
WHY TRANSFER MOLDING IS ECONOMICAL—I.

Among the reasons why transfer molding achieves greater economy is the fact that this process makes fullest use of all the advantages of high frequency preheating. The combination of high frequency preheating and transfer molding results in an increase of molding production speeds of as much as several hundred percent.

For, even without high frequency preheating, transfer molding of phenolics, ureas and melamines is efficient. In contrast with older molding methods, the thermosetting compound is changed to its plastic state in a chamber connected with a closed mold, rather than in the mold itself. The plasticized compound then flows under pressure from the chamber into the mold, which may have many cavities. After "curing," the mold is opened for ready removal of parts.

When older methods are used in combination with high frequency preheating, the operator must work back and forth from the preheater to the mold, with a preform for every cavity. When transfer molding is combined with high frequency preheating, the operator can load a single charge per press operation.

Typical of the pieces which can be produced more speedily with transfer molding is the block at right, approximately 9¼" long.



SHAW

SHAW INSULATOR COMPANY

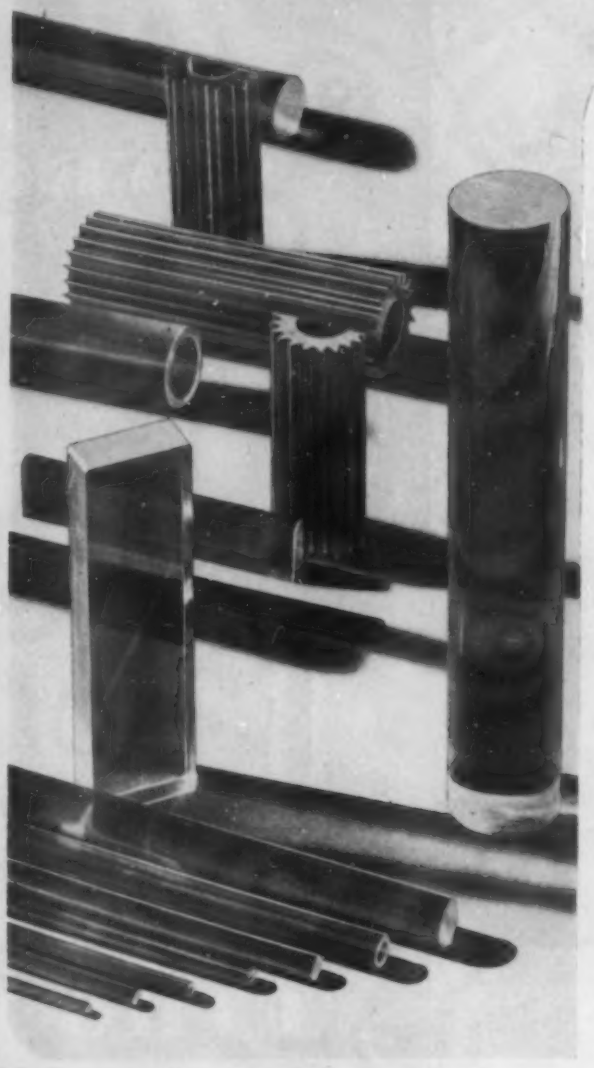
100 COIT STREET, ★ IRVINGTON 11, NEW JERSEY

There are licensed transfer molders near you. A list of them, a bulletin on "Why Transfer Molding Gives Fine Inserts", and reprints of technical articles by Shaw engineers will be mailed on request.

Between the resources of Plax Corporation, Hartford 5, Conn., and those of Shaw—which have been growing since 1892—you will be able to obtain advanced help in the application to your specific needs of a broad range of plastic materials and processes.

For informed help with your product problems, and for the names of licensed transfer molders near you . . . write Shaw.

PLAX METHACRYLATE ROD, TUBING AND FIBER



Methacrylate is supplied by Plax in various sizes and shapes of rods and tubing, and in fiber—in all colors, from clear to pearlescent. Characteristics are as follows:

MECHANICAL

Elongation, %	1-5
Tensile Strength, p.s.i.	4,000-7,000
Modulus of Elasticity in Tension, p.s.i.x10^5	3-5
Compressive Strength, p.s.i.	10,000-12,000
Flexural Strength, p.s.i.	10,000-17,000
Rockwell Hardness	M40-M70
Impact Strength, ft. lbs. per in. of notch; ½" x ½" notched bar Izod test	0.2-0.4
Water absorption, 24 hrs., %	0.4-0.5

ELECTRICAL

Volume Resistivity, ohm. cms. (50% rel. hum. at 25°C)		10^{13}
Dielectric Strength, short-time volts per mil, ⅛ in. thick		500
Dielectric Strength, step-by-step volts per mil, ⅛ in. thick		400
Frequency	Dielectric Constant	Power Factor
60	3.0-3.7	0.05-0.07
10^3	3.0-3.5	0.06-0.07
10^6	2.8-3.3	0.02-0.03

THERMAL

Distortion Temperature, °F	125-165
Transition Temperature, °F	145-185
Softening Point, °F	150-230
Specific Heat, cal. per °C per gram	0.35
Burning rate	Slow
Thermal Expansion, 10^{-5} per °C	7-9
Thermal Conductivity, 10^{-4} cal. per sec. per sq. cm/1°C per cm.	5-7
Resistance to Heat (Continuous) °F	120-160

CHEMICAL EFFECTS

Weak Acids	Practically nil
Strong Acids	Affected only by oxidizing acids
Weak Alkalis	Practically nil
Strong Alkalis	Practically nil
Alcohols	Attacked above 40%
Esters	Dissolves
Ketones	Dissolves
Aromatic Hydrocarbons	Dissolves

Liquid sight gauges, transparent models, high frequency insulation, pen and pencil parts, filtration equipment parts, decorative architectural forms, jewelry, etc. may all be advantageously produced from Plax methacrylate rods, tubing and fiber. Methacrylate has unique optical properties . . . For data on stock sizes, write Plax.

The following illustrated literature is available:

Several bulletins on Plax polystyrene products and how to machine them.

Data on Plax cellulose acetate and cellulose acetate butyrate products.

An article on Plax's blown products.

Ethyl Cellulose, Polyethylene and Styramic are among the other materials offered by Plax in various forms. In cooperation with Shaw Insulator Company, Irvington 11, N. J., Plax can give you help covering nearly all plastic materials and methods. For such help, or for any of the literature listed above . . . write Plax.

PLAX
FOR PLASTICS
NOT SUBSTITUTES···IMPROVEMENTS

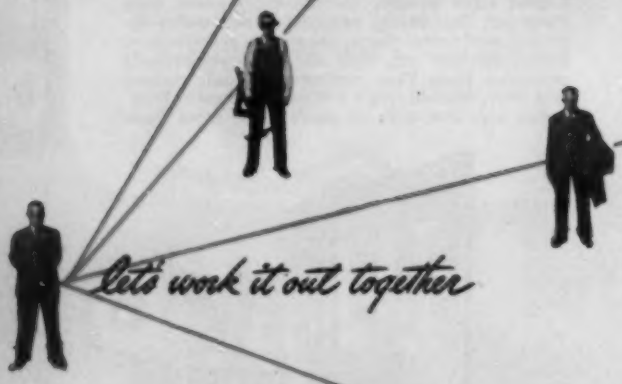
133 WALNUT STREET ★ HARTFORD 5, CONNECTICUT

put them in their RIGHT place!

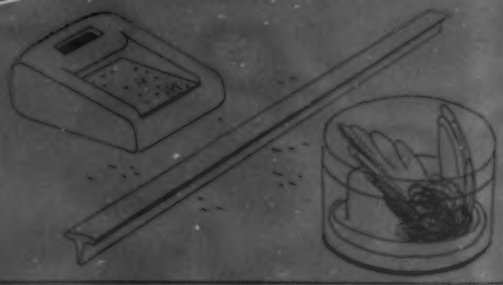
SARAN

STYRON

DOW



ETHOCEL



We at Dow know from experience that success in plastics is not a one-man nor even a one-industry job. It calls for the combined skill and cooperation of manufacturer or designer plus fabricator plus raw materials producer. Working together, this team saves time and money and puts plastics to work successfully. Call us—we'll do our part.

EASILY FABRICATED IN THESE FORMS

STYRON (Dow Polystyrene) . . .
For moldings, extrusions, rods, sheets.

SARAN . . .
For moldings, extrusions, pipe, tubing, sheet, monofilaments; also available as Saran Film.

ETHOCEL (Dow Ethylcellulose) . . .
For moldings, extrusions, coatings; available also as Ethocel Sheeting.

Present and Potential Uses

Plating masks; chemical apparatus; pump parts; valves and valve parts; name plates; meter parts; paint brush handles; insulation; stoppers; funnels; bottles; closures; plumbing parts and equipment; wire coating, etc.; pipe and tubing for installations requiring chemical and corrosion resistance.

Properties and Advantages

Resistant to chemicals, abrasion, corrosion, water, and moisture; good electrical insulator; excellent thermal insulator; nonflammable; tough; flexible; dimensionally stable; not recommended for installations requiring temperature resistance above 170° Fahrenheit; tends to brittleness at very low temperatures.

Present and Potential Uses

Lighting fixtures; insulators; battery cases; hydrometers; funnels; bottles; closures; food handling equipment; pharmaceutical, cosmetic and jewelry containers; costume jewelry; novelties; refrigeration parts; pens; pencils; liquor dispensers; escutcheons; chemical apparatus; dishes; lenses; decorative objects, trim.

Properties and Advantages

Clear, translucent or opaque; broad color range; excellent high frequency electrical insulator; can "pipe" light through rod at angles, around corners, etc.; resistant to acids and many alkalies; low water absorption; light weight; stable at low temperatures; limited solvent resistance; available only in rigid forms.

PLASTICS

Present and Potential Uses

Housings; radio cabinets; aircraft parts; containers; insulators; flashlights; automotive parts; escutcheons; refrigerator parts; tool handles; rods, tubes, bars, and special extruded shapes for kitchen trim; automotive and aircraft window frames; modern window blinds. Also used as tape and wire coating.

Properties and Advantages

Extra tough, particularly at low temperatures; attractive colors; pleasant to handle; transparent or translucent; dimensionally stable to varying climatic conditions and temperatures; light in weight; available in wide range of flow; not available in crystal color; limited chemical and solvent resistance.

THE DOW CHEMICAL COMPANY
MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit
Chicago • St. Louis • Houston • San Francisco • Los Angeles • Seattle

The amazing copy-cat

Buy More War Bonds

Like the copy-cat, this machine has no ideas of its own. But therein lies its tremendous value to mass production industry. It is one of Allied's duplicating machines—a five by ten foot Keller. From a master model, it is swiftly and exactly reproducing a propeller blade form in a piece of steel. And the copy will soon be turning out numberless, faultless airplane propellers as painstakingly, as deftly and as *precisely alike* as could a thousand skilful craftsmen working a thousand times longer.

This amazing Keller "copy-cat", one of Allied's eight duplicating machines costing well over a quarter of a million dollars, illustrates Allied's policy of combining the finest of mechanical equipment with the maximum in skill and experience. It is this rigid adherence to an ideal of quality in both equipment and craftsmanship which has made Allied a standard source of supply for many mass-production industries. And because of wartime expansion, Allied is equipped and staffed to give a greater range of service than ever. Anticipate your postwar requirements and check with Allied now. Send blueprints for estimates or write, today.

• • •

"IT'S AN ALLIED PRODUCT" . . . Allied Products Corporation's Richard Brothers and Victor-Peninsular plants, Detroit and Hillsdale, Michigan, make sheet metal dies (from the largest to the smallest), R-B interchangeable punches and dies, steam-heated plastic molds, jigs and fixtures, special production tools, hardened and precision-ground parts, cap screws, and cold-forged parts.

ALLIED PRODUCTS
CORPORATION

Department 21, 4622 Lawton Avenue, Detroit 8, Michigan

A CINCH FOR US!

A *cinch* FOR YOU

In the designing room of CINCH many of radio's most serviceable features, represented by small metal plastic parts, were "born". Here you MEET MEtal Plastics Engineering "at tops" at the start. And when having expressed the need, you watch it supplied, following thru from its inception, visualized on the drawing board, on through the many phases of modern manufacturing, you know that what is "A Cinch for us" must result in "A CINCH for you". For example: the Diheptal socket in communications. CINCH offers a complete metal plastic service for small and intricate assemblies.

CINCH MANUFACTURING CORPORATION

2335 WEST VAN BUREN STREET • CHICAGO 12, ILLINOIS

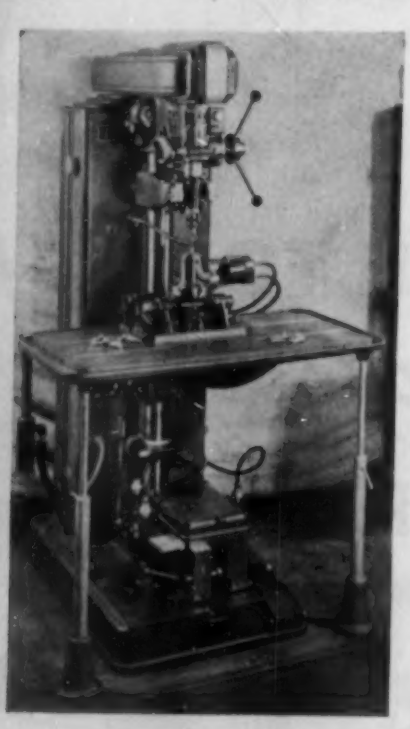
SUBSIDIARY OF UNITED-CARR FASTENER CORPORATION - CAMBRIDGE, MASS.

No. 2 of a Series of Advertisements: "MEET MEtal Plastics Engineering"

NEW MACHINERY AND EQUIPMENT

★ NORTON CO., WORCESTER, Mass., is marketing a line of solid polishing wheels which make it possible to meet the special requirements of a wide range of de-burring, finishing and polishing operations. These wheels are available under the trade mark Norflex in three types—cork resinoid, fiber resinoid and resilient rubber.

★ MARKED INCREASE IN PRODUCTION is claimed by Zagar Tool, Inc., Cleveland, Ohio, with the use of their standard Zagar Air-O holding fixture, in conjunction with the new Warner and



Swasey precision tapping and threading machine which turns out one piece every three seconds. The fixture is tipped about 20 degrees for loading and unloading by a special mounting, which saves time normally consumed in raising the spindle from the work. Standard 14 AC No. 2 collets are used and provisions are made for stoping the fixture when duplicating parts.

★ MANY IMPROVEMENTS AND A wider range of types have been added to the line of Northmaster kneading machines manufactured by Struthers Wells Corp., Titusville, Pa. Engineer-designed for performing difficult mixing, kneading and processing operations on materials ranging from dry and moist powders to heavy plastic masses, these high-powered mixers are used for breaking down and for developing high-viscosity cements and coatings and for compounding fillers and other difficult materials in heavy plastic masses. Special serrations on blade edges and trough saddle adapt the units to the mixing and shredding of cellulose paper and other fibrous substances in fluid mediums or in combinations with other materials.

★ A PROCESS FOR CONSTRUCTING new thread gages or salvaging old ones worn beyond tolerance limits has been developed by George O. Griffin Co., Whittier, Cal. The threads are removed from old gages, welded on a solid deposit of chrome-carbide alloy and new "on size" threads ground on the wear-resistant deposit. Gages made or reclaimed by this method are claimed to outwear ordinary thread gages by at least 20 times.

★ AN UNUSUAL HEATING POT has been designed by Kindt-Collins Co., Cleveland, Ohio, for melting and maintaining liquidity of such diverse materials as shellac, kerosene, turpentine, waxes, low-melting-point metals and certain plastics. The heating element operates with a vacuum sealed fluid, circulating between inner and outer shells of pot, which requires no replacement. Advantages of the pot include automatic electric heat, permanent wet-, fire- and explosion-proofness and maintenance of uniformly low temperature. At present the unit, which weighs 8¼ lb., is made in 2-qt. capacity.

★ IN THE NEWLY DESIGNED COLlet manufactured by Sheffer Collet Co., Traverse City, Mich., a "cup-point" lug which penetrates the stock slightly with the collet in the locked position, is incorporated in each serrated section. Identified as "Super Grip," the lugs are usually set 0.010 to 0.015 in. above regular serrations and can be adjusted for more or less penetration, or can be turned away completely, leaving effective only the standard serrations, all without removing the collet from the machine.

★ A SKIP TOOTH BAND SAW, DEsigned for faster, easier cutting of magnesium, aluminum, soft brass, other nonferrous metals, plastics, composition, fiber and wood, has been introduced by W. O. Barnes Co., Inc., Detroit, Mich. The saw is of hard edge, flexible back construction and fits any standard band saw machine; no resharpening is necessary since it can be used until worn out.

★ AN INSTRUMENT RAPIDLY REplacing the Bull's Eye sight flow indicator is the compact Rotasight flow rate indicator announced by Fischer & Porter Co., Hatboro, Pa., which indicates true flow rate of water or lubricants in machinery. Operating on the rotameter area-type principle, the instrument has a V-ported transparent metering tube with a float which rises in direct proportion to the flow of the liquid through the meter.

★ MODEL X875 THERMEX RED Head is claimed to be the most compact high-frequency heating unit yet developed by Girdler Corp., Louisville, Ky. Weighing but 250 lb., the unit will fit into the space usually left between presses. A built-in heating cabinet and removable tray make the machine practical and flexible. It has an output of 400 watts; ordinary 230 volt, 60 cycle single-phase current is used.

★ THE ASSURANCE OF CORRECT alignment and spacing of characters when stamping details in nameplates is an advantage gained through the use of a hardened steel guide and spacing block, recently developed by Numberall Stamp & Tool Co., Huguenot Park, Staten Island, N. Y. The block is available for various sizes of characters and nameplates.

Sorry!

★ IN THE FEBRUARY ISSUE OF MODERN PLASTICS, page 204, the 16-oz. Lester-Phoenix injection molding machine was erroneously identified in the advertisement a 6-oz. machine.

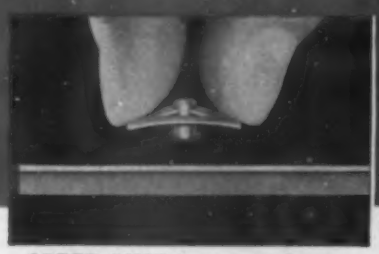
This machine is designed with a vertical injection cylinder having a hollow plunger

and ring-shaped heating chamber. It produces a more uniform heat concentration in the material, plasticizes the charge at 10 to 30 percent higher than conventional machines and delivers the charge into the mold cavity without loss of applied pressure.

ONE OF A SERIES PORTRAYING "THE SPEED NUT FAMILY OF FASTENERS"

PUSH-ON SPEED NUT

JUST A *Push* AND IT LOCKS!



SPEED NUT is started over stud by hand . . .

. . then pushed down on stud with tool.

Parts are held together with firm spring tension lock.

● It's just as simple and easy as that! For this unique spring steel fastener needs only to be *pushed* over rivets, nails, tubing, wire, integral die cast or plastic studs to lock parts firmly together. Threads are unnecessary because the spring prongs of the nut provide a friction *lock* on even the smoothest of chrome surfaces.

But easy attachment is not the only advantage gained by using Push-On type SPEED NUTS. Costly threaded inserts, drilling and tapping are eliminated — molding costs reduced — assembly speeded up — and vibration loosening prevented. These fasteners are available in many sizes and shapes . . . rectangular, square, round, or they may be specially designed to fit your particular requirements.

If you want to improve the attachment of name plates, emblems, trim strips, grilles, or other light-weight parts, write now for samples of Push-On type SPEED NUTS, giving *stud diameter* and any other pertinent assembly details.

TINNERMAN PRODUCTS, INC.
2048 FULTON ROAD, CLEVELAND 13, OHIO
In Canada: Wallace Barnes Co., Ltd., Hamilton, Ontario
In England: Simmonds Aerocessories, Ltd., London

Speed Nuts®
PATENTED
®Trade Mark Reg. U. S. Pat. Off.

FASTEST THING IN FASTENINGS

THE BASIC PRINCIPLE of Spring-Tension Lock is Embodied in all Speed Nut Designs

WASHINGTON ROUND-UP

R. L. VAN BOSKIRK, Washington Editor

More synthetic rubber for raincoats

Vinyl raincoats for the Army may be passing out of the picture, temporarily at least. The Army would like to get all raincoats in synthetic rubber. However, it will take many months before a complete turnover is possible because the material must be vulcanized and there are not enough facilities to handle this volume. About 25 percent of the coats purchased heretofore have been rubber coated.

The reason for this switch from vinyl to synthetic rubber coating is the superior flexibility of synthetic rubber coats over vinyl coats under winter conditions. There is also a large supply of synthetic rubber and the cost is slightly less. A vinyl raincoat for the Army costs about 30 to 35 cents more than a synthetic rubber raincoat. Figures are not available which would indicate how much of this difference might be traced to the Government subsidy for synthetic rubber. The Army clothing bag, which has been furnished with a vinyl coating, has also been changed over to synthetic rubber presumably for the same reason.

There has been no complaint of the vinyl cracking. The problem is simply one of flexibility when the thermometer goes a number of degrees below freezing. It is still felt that where light weight is desired, vinyl coating is superior to rubber coating because of better sunlight, abrasion and hydrostatic resistance. When the weight of the coating needed is less than 6 oz. per sq. yd. of fabric, vinyl coating is still the choice of the Army. This would include ponchos and a few other coated items, and even material of heavier weight when it is destined for wear in tropical or semi-tropical areas.

A continuous study is being made by the special group headed by Capt. William H. Aiken of the Quartermaster General's office at Brooklyn Polytechnic Institute of the use of various plasticizers with vinyl resins, with the intent of improving low-temperature flexibility characteristics. Among the plasticizers mentioned as showing promise is tri-octyl phosphate. It is possible that new facilities may be constructed so that greater quantities of this plasticizer may become available to the industry.

No methanol for antifreeze

While no methanol antifreeeze will be available for the 1945-46 season, the supply of the permanent type of antifreeze (ethylene glycol) will approximate last season's output, according to a WPB announcement. No antifreeze will be made from methanol because of a need for this chemical in the production of formaldehyde for increased munitions programs.

Time extension for use of allocated chemicals

Simplified procedure to obtain extension of authorization for use of allocated chemicals was announced recently by Chemicals Bureau, WPB. A letter may now be written to the WPB, Chemicals Bureau, Allocations Officer, Washington 25, D. C., listing all allocated chemicals and allied products for which an extension of authorization for use is requested beyond the limit set by Order M-300, Paragraph (v) or by any other Chemicals-Bureau order.

In this letter, the applicant should list each material, the applicable M-300 schedule or other order, each use for which authorization has expired, the unused quantity previously authorized for that use, the original allocation period, the data the material was ordered from the supplier, the requested shipping date, date of arrival, and requested time extension. If a number of materials are to be used together, this fact should be mentioned in the letter.

Shipping difficulties have in some cases caused allocated materials to arrive after the allocation period, WPB pointed out. West Coast manufacturers in particular have been handicapped by late shipment. Difficulties are complicated by the fact that late arrival of one allocated chemical may delay use of other allocated chemicals required for the same purpose. Under Order M-300, Paragraph (v), allocated materials not used by the end of the month following the allocation period revert to inventory and cannot be used without further WPB authorization.

Award for chemicals bureau

J. A. Krug, Chairman of the WPB has announced that an "Award of Achievement" has been conferred by the Ordnance Department of the Army upon the Chemicals Bureau of WPB. The award was made "in recognition of distinguished services and signal cooperation in connection with the accomplishment of the Ordnance Manufacturing and procurement program." Presentation of the award was made by Maj. Gen. Levin H. Campbell, Jr., Chief of Ordnance of the United States Army, to Dr. D. P. Morgan, director of the Chemicals Bureau.

Need for coated fabrics

The urgent need for coated fabrics to fill a new Signal Corps requirement was discussed recently by the Pyroxylin and Vinyl Resin Coated Fabric Industry Advisory Committee, according to a WPB report. Each coater in the industry who has any excess facilities suitable for this work should notify WPB and obtain details of the new requirement, WPB emphasized. If the coated fabric industry is unable to meet this requirement, it might necessitate a review of the entire industry for the purpose of eliminating certain civilian work to provide capacity for the production of essential materials to supply the immediate needs of the Signal Corps, the WPB report added.

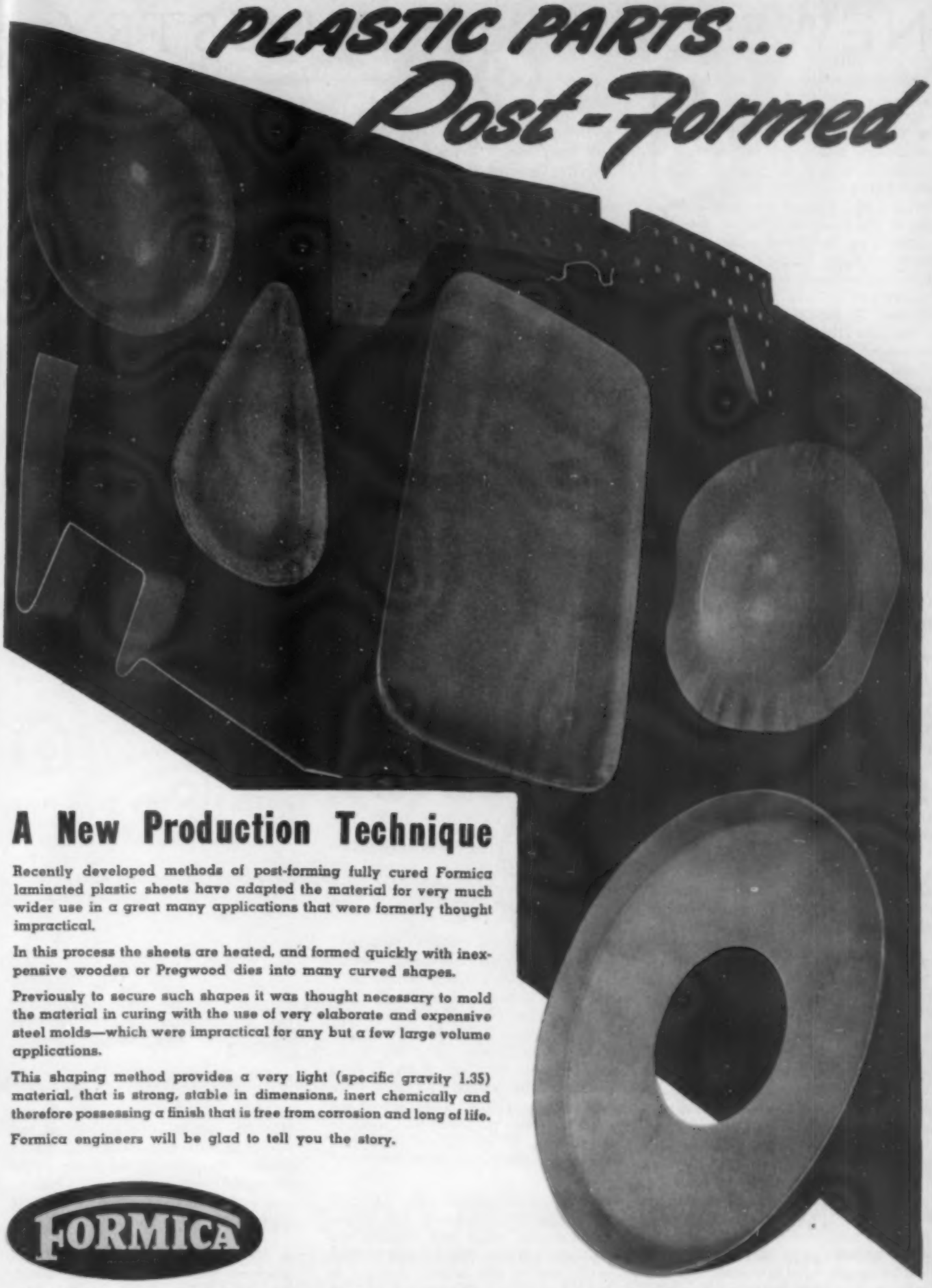
The military and civilian status of major raw materials used by the industry were explained by the WPB commodity men involved. Very limited quantities of resins, plasticizers and iron oxide, will be available for civilian use, they reported. Military needs for solvents will be met in full. Solvents will be available in limited quantities for use in essential civilian applications, the advisory committee was also informed.

Government keeps close watch on violators

Reports from the trade following the recent conviction of a plastics operator for violation of WPB orders indicate that there are suspicions and rumors concerning a few possible violations in other quarters. Inquiry among WPB officials indicates that they are aware of the suspicions. Up until recently the Compliance Division had been reluctant to prosecute in criminal court and was rather lenient in overlooking or punishing either willful or unintentional violations. But since materials have been so extremely scarce during the last few months, the Compliance Division is inclined to be more hard boiled in its future investigating and prosecuting of any reported violators of the WPB orders.

Another closely watched prospective evil is the possibility of inflating requests for material intended for military use. When molding powder is so hard to get, it is possible that unscrupulous operators might possibly inflate their military demands. WPB officials admit that it is not possible to estimate to the closest pound, and that cancelled orders sometimes result in comparatively large quantities left on hand. In such cases there is not likely to be any trouble. Intentional misstatements of the amount of material needed is outright perjury and makes the offender liable to a severe fine and a possible prison sentence when this practice is discovered by the WPB.

PLASTIC PARTS... Post-Formed



A New Production Technique

Recently developed methods of post-forming fully cured Formica laminated plastic sheets have adapted the material for very much wider use in a great many applications that were formerly thought impractical.

In this process the sheets are heated, and formed quickly with inexpensive wooden or Pregwood dies into many curved shapes.

Previously to secure such shapes it was thought necessary to mold the material in curing with the use of very elaborate and expensive steel molds—which were impractical for any but a few large volume applications.

This shaping method provides a very light (specific gravity 1.35) material, that is strong, stable in dimensions, inert chemically and therefore possessing a finish that is free from corrosion and long of life.

Formica engineers will be glad to tell you the story.

FORMICA

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NEWS OF THE INDUSTRY

★ THE GIRDLER CORP., LOUISville, Ky., announces the election of George O. Boomer as president to succeed Walter H. Girdler, Sr., who died recently. Mr. Boomer has been a member of the Board of Directors since the company was founded and executive vice-president since 1938. He will remain vice-president and a member of the Board of Directors of Tube Turns, Inc., an affiliate of Girdler Corporation.

Thermex Division of Girdler Corp., announces the appointment of Boyd R. Hopkins as East Central district representative, with offices at 1836 Euclid Ave., Cleveland, Ohio. Mr. Hopkin's territory includes Ohio, northeastern Indiana, eastern Michigan, western Pennsylvania and certain areas in Canada.

★ THE FACTORY AND OFFICES OF Plasticote Co., textile coaters, have been moved to 9 Erie St., Paterson, N. J. Machinery from the company's Ossining, N. Y., plant (now closed) will be installed to permit the company to apply newer types of synthetic resin coatings to fabrics as they become available.

★ CHARLES C. LAYMAN HAS ACquired full control of Evans Chemical Corp., Detroit, Mich., manufacturers of Econite, all-purpose plastic filler. Leslie E. Evans, former president of the corporation, has retired to do private research work in plastics.

★ THE STAFF OF BATTELLE INstitute, Columbus, Ohio, has been augmented by the addition of Dr. M. H. Chetrick and Dr. John W. Clegg. Dr. Chetrick, a chemical engineer, will engage in chemical research, and Dr. Clegg's work will be in the field of organic chemistry.

★ A CONTROLLING INTEREST IN Makalot Corp., Boston, Mass., has been acquired by Interlake Chemical Corp., Cleveland, Ohio, according to a recent announcement by M. M. Makeever, president of Makalot. Interlake, which is owned jointly by Interlake Iron Corp. of Cleveland and Great Lakes Steel Corp. of Detroit—the latter a wholly owned subsidiary of National Steel Corp. of Pittsburgh—purchased Central Process Co., which had a resin plant, in April 1944.

Interlake Chemical has no plans for moving the Makalot plant or for doing any compounding at Cleveland. Resins, molding compounds (including K.E.M.) and adhesives bearing the Makalot name will still be manufactured in Boston. Mr. and Mrs. Makeever will also continue to serve the company as consultants.

★ DR. HORACE E. RILEY, CHAIRman of the North Jersey Section of the American Chemical Society has announced the choice of Dr. Edwin Richard Gilliland as first recipient of the Leo Hendrick Baekeland Award in that Section. The award was made for Dr. Gilliland's outstanding achievement in the fields of heat transmission, diffusion, distillation and high-pressure synthetic chemistry.

★ BERNARD W. SLATER HAS BEEN appointed manager of operation, Plaskon Div., Libbey-Owens-Ford Glass Co., Toledo, Ohio. He will supervise the manufacturing, accounting, purchasing and maintenance engineering departments of Plaskon. Dr. A. M. Howald will assume the duties of technical director in charge of research and technical service departments of both Plaskon Division and Paramet Corp., manufacturers of synthetic resins used in paint, and a subsidiary of Libbey-Owens-Ford in Long Island City, New York.

★ THE EXECUTIVE OFFICES OF Protex Products Co., manufacturers of Protex film plastics, have been moved to 44-50 Sherman Ave., Jersey City, New Jersey.

★ IDEAL PLASTICS CO., LONG ISland City, N. Y., has acquired United Plastics Corp., Cleveland, Ohio, and plans are being made to modernize and operate the facilities of the latter as an affiliate concern.

★ WALTER T. JOHNSON HAS BEEN appointed district sales manager for Columbia Chemical Division, Pittsburgh Plate Glass Co., in Chicago.

★ A NEW LIGHTWEIGHT, WATERproof packaging and fabricating material to be known as Vitafilm, which can be woven into fabrics and offers a wide range of current and postwar possibilities, has been announced by Goodyear Tire and Rubber Co., Akron, Ohio. In the six gages of sheet form in which it is being produced, the material is adapted for food bags, bowl covers, garment bags and other household purposes—heat sealed or stitched, it is suitable for umbrellas, raincoats and similar products.

★ B. F. GOODRICH CO., AKRON, Ohio, announces Plastilock 500, a nonthermoplastic, water and aromatic oil-resistant adhesive for bonding metals, wood, plastics and ceramic material to themselves or to each other. The company claims that in some of its applications it can be used in place of rivets or screws. Bond strength varies with the materials being adhered. In metal-to-metal bonding, shear strength of 3250 p.s.i. have been reached and tension strengths as high as 4000 p.s.i.

★ A WEST COAST TECHNICAL Committee has been formed by the Resin Adhesive Div., Plastics Materials Manufacturers' Association, in recognition of the importance of resin adhesives in the manufacture of plywood products. Members are: chairman, C. E. Rozema, Resinous Products and Chemicals Co.; John Stephan, I. F. Laucks, Inc.; Hal B. DeWaide, Bakelite Corp.; E. E. Graham, Durex Plastics and Chemicals Co.; and B. Pelley, Balfour Guthrie & Co., Ltd., representative of Catalin Corporation. The primary object of the committee at this time is to cooperate on technical matters with the Armed Services, Government laboratories, Douglas Fir Plywood Association, and individual fabricators of products employing resin glues.

★ HOMALITE CO., 725 N. DU PONT Road, Wilmington, Del., has been formed by R. L. Malamphy, formerly with American Cyanamid Co., and Walter Hoover, previously connected with U. S. Rubber Co. The company will engage in the development and fabrication of cast and low-pressure laminated plastics, using unsaturated polyesters.

★ FABRIKOID DIV., E. I. DU PONT de Nemours and Co., Inc., will be known in the future as the fabrics division of the fabrics and finishes department. The change was made because of the greater diversification of the division's production of coated fabrics for the Armed Forces.

★ RESIN INDUSTRIES, SANTA Barbara, Calif., producers of thermoplastic synthetic resin insulating materials, announce the location of a branch office at 3902 W. Sixth St., Los Angeles, under the supervision of Perry Goodspeed.

★ TO COORDINATE RESEARCH and development activities of The Trion Co., Riegel Textile Corp. and Ware Shoals Mfg. Co. and Bleacher, the Riegel Development Laboratories, Inc., have been formed. President of the newly established organization will be J. F. Warner, who will make his headquarters at 342 Madison Ave., New York City.

★ NICHOLAS J. JAMMAL HAS BEEN appointed works manager of the Morrisville, Pa., plant of Vulcanized Rubber Company.

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Impact testing

(Continued from page 149)

Most of the thermoplastics exhibit a wide variation in impact strength as the temperature is varied. Most reach a brittle range if the temperature is lowered considerably. Figure 5 illustrates the variation in impact strength of cellulose acetate sheet plastic with temperature under three different conditions of notching. Ductile-to-brittle transitions similar to these are observed for metals. It is interesting to note that cutters Nos. 1 and 2 result in the same transition temperatures, although cutter No. 1 results in a lower impact strength in the ductile region. On the other hand, cutter No. 3, with a slower cutting speed, shifts the transition temperature 15 to 20° C. higher, and also produces a much lower impact strength in the ductile region. Even in the brittle region, this cutter results in a lower impact strength. Such behavior would be expected if this cutter produced a smaller radius at the bottom of the notch, or if it resulted in a rough or ragged notch. Actually, the latter was the case.

Summary and conclusions

To sum up, certain well-recognized facts concerning impact strength have been reviewed. These may be listed as follows:

1. The energy to fracture depends on both the force required and the deformation produced, and for brittle materials is approximately equal to Equation 2:

$$W = \frac{PS}{2}$$

2. The deformation may or may not be ductile, depending on the material and on the conditions of temperature, speed and the state of stress.

3. If the failure is brittle, the energy absorbed may be correlated directly with the dimensions of the specimen, the elastic modulus, and the maximum tensile stress which the material is capable of supporting.

In addition, experimental results involving the effects of specimen dimensions, notching, temperature and speed are presented. Evidence is given that for many plastics the tensile strength is a linear function of the logarithm of the stressing rate over a relatively wide range of the latter.

Hazen (24) has pointed out some of the consequences of Equation 2. He regards "toughness" as measured by the area under the load-deflection curve in flexure, as being a more reliable indication of impact resistance than the rating as given by the standard Izod or Charpy impact test, and gives considerable experimental evidence in support of this view. Our experience has been in agreement with Hazen's. As a matter of fact, if our knowledge of the effect of speed were more complete, it might appear that there exists very little need for a conventional impact test in the field of plastics. A knowledge of the effect of speed and temperature on the tensile strength and modulus of elasticity of brittle materials should allow us to predict their toughness under a wide range of conditions.

When ductility is involved, however, there exists a need for a test or series of tests which will enable one to estimate whether or not plastic deformation will take place under a given set of conditions. One approach to this problem would be that of determining a) the so-called technical cohesive strength (26–28), and b) the yield value of the shear stress under a variety of conditions. Another approach, suggested by Seely (25) and again by deForest (9), is that of setting up a series of standard specimens which cover a range of $\sigma_{max.}$/$\tau_{max.}$ values, and locating the position of the ductile-to-brittle transition under a variety of conditions with respect to this series of specimens.

The importance of the state of stress produced in the specimen during a test should be emphasized. Our experience forces us to believe that this is one of the most important factors in impact testing. Its critical nature is demonstrated clearly by the brittle-ductile transitions arising solely from changes in dimensions, a phenomenon which has been observed in the Charpy impact testing of steels.

The common belief that impact tests are physically unique may be attributed largely to a general lack of understanding among engineers as to the importance of stress states. This is no criticism, since even among experts the knowledge of this subject is at best rudimentary. Good progress is being made, however, and the time may not be far off when it will be possible to obtain an accurate picture of the engineering properties of a plastic from a relatively few laboratory determinations made at several conditions of stress state, temperature and testing speed. When this can be done, present distinctions between static and impact tests need no longer exist.

Acknowledgments

The authors are indebted to R. K. Swank for some of the experimental data which have been presented. M. E. Mark's permission to use the data represented in Fig. 2 is also appreciated.

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A modified haze meter

(*Continued from page 150*) box with a hinged top and a dull black interior. In operation, the procedure followed is to adjust the intensity of the lamp so that the microammeter reads 100. If the apparatus is arranged in the usual wooden box, the lid is lifted and the specimen inserted at one of the two test positions. One test position is with the specimen held flat against the aperture of the light source while the other is with the specimen flat against the aperture at the photoelectric cell.

Experience with the above arrangement indicates that:

1) The maximum intensity of the light source at rated voltage is not always sufficient to give a 100-microampere reading on the meter.
2) It is necessary to readjust the light source frequently to compensate for a change in the battery voltage.
3) The simple lamp and reflector arrangement produces a divergent beam of light.
4) The current-illumination relationship is not linear because of the resistance of the meter.
5) Slight changes in the photoelectric cell current are not easily detectible on the meter.
6) The arrangement of the wooden box requires that the lid be lifted each time the specimens are inserted or shifted in the test positions. The size of the box limits the test to small specimens.

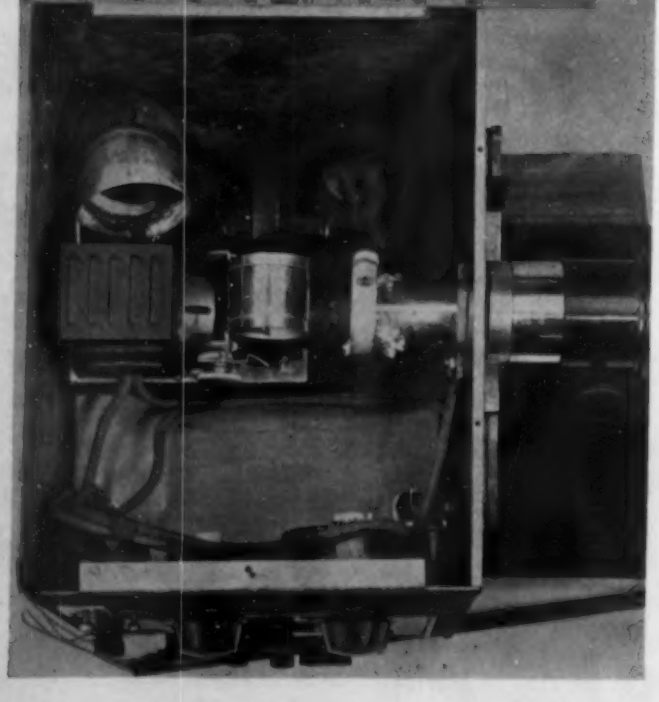
In an attempt to minimize these limitations, the authors modified the Axilrod-Kline-Bowen type instrument in the following manner:

Arrangement—The arrangement shown in Fig. 2 has been found to be advantageous because it eliminates the necessity for a dark room or enclosing box. By removing the diaphragms on the ends of the horizontal tube, specimens up to $1^1/_2$ in. in thickness can be tested. The centerline of the optical system is 10 in. above the base and therefore permits the testing of all portions of specimens up to 20 in. wide.

Light source—A conventional arrangement of the Axilrod-Kline-Bowen haze meter has been used by the authors. This apparatus utilized an automobile type "sealed-beam" headlamp from which the glass lens was removed. This light system did not provide a parallel beam of light, even though the large filament was carefully focussed. As a parallel beam of light is desirable in order to obtain perpendicular incidence on the surface of the specimen being tested, the above instrument was modified to use a commercial projector (Model M)[1] as a light source, as shown in Fig. 3. This is a compact unit designed for projecting 35-mm. still pictures and is normally equipped with a 50-watt lamp, double-condensing lenses and a suitable color-corrected projector lens. The 50-watt lamp is replaced by a 100-watt lamp of the same type to provide greater light intensity which gives the additional scale deflection not obtainable in the original apparatus. The small blower shown in Fig. 3 serves to cool the projector when a 100-watt lamp is used. The consistent results obtained with this light source warranted a redesign of the apparatus to provide greater flexibility and ease of operation. Figure 2 shows the redesigned haze meter now in use by the authors. This apparatus utilizes the projector described above and is operated from a regulated voltage supply which has been found to be more satisfactory than a storage battery supply. The use of diaphragms at the ends of the horizontal tube serves to eliminate any diffused light.

Electrical measuring circuit—The bridge circuit for measur-

[1] Society for Visual Education, Chicago, Ill.



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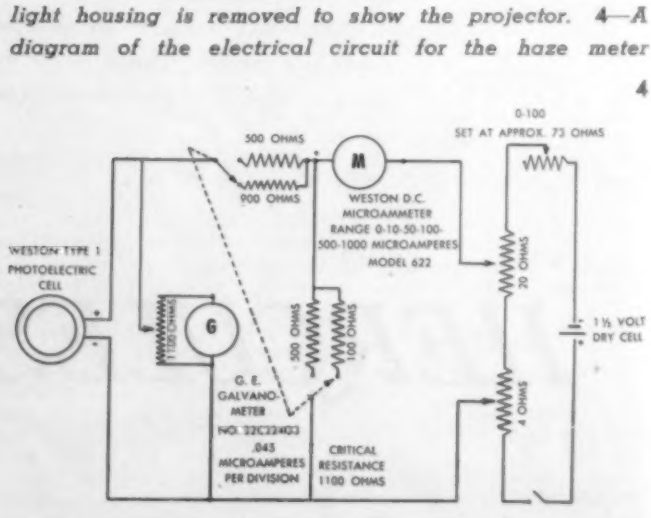
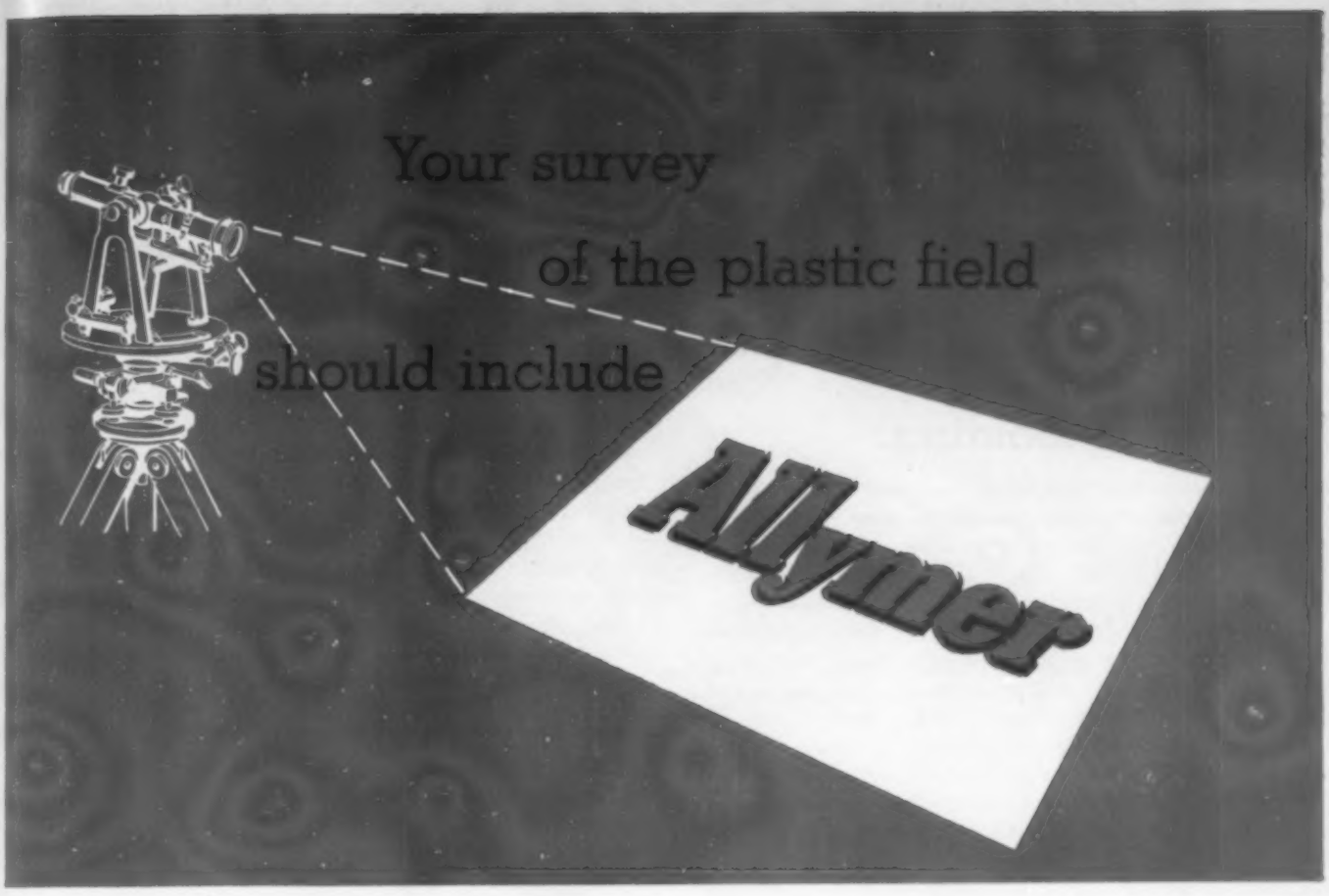
3—Top view of the modified haze meter. The cover of the light housing is removed to show the projector. 4—A diagram of the electrical circuit for the haze meter

4





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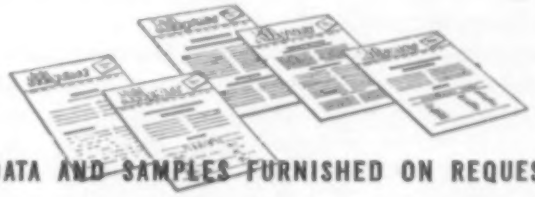

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ing the potential of the photoelectric cell is shown in Fig. 4. This arrangement provides a method for obtaining the equivalent of a zero external resistance and thereby gives a linear cell current-illumination relationship which is highly desirable for more accurate results. In addition, a selector switch as shown in Fig. 4 multiplies the range by either 2 or 10 times, providing amplification for the photocell current so that larger meter deflections are obtained.

Acknowledgment

The authors wish to thank H. Nestlen for his technical advice and S. E. Yustein and M. Gilman for their assistance.

Impression molding

(*Continued from page 137*) tween rigid dies, no more molding pressure would be required than if the same material were molded by one of the "impression" molding methods.

In commercial practice, the materials are not carefully calendered. Therefore, differences in molding pressure occur due to the material's being forced to flow when molded between rigid dies, while no such flow is necessary when using one of the "impression" molding methods. It is this lack of flow in the case of the "impression" molding methods which is largely responsible for the poor surface definition on the surface not controlled by the rigid die.

From the above it is evident that the common denominator of all the "impression" molding methods is that a single surface of the product is accurately controlled. In contrast, the common denominator of the so-called high-pressure molding methods is the accurate control of both surfaces of the product. It is this essential difference in the characteristics of the products which serve as a basis for differentiation.

Let us therefore define "impression" molding, or laminating, as "single-die" molding or laminating; and define so-called high-pressure molding, or laminating, as "double-die."

New uses for materials

(*Continued from page 97*) wood (15), while C. Dreyfus has described various metal-plastics and wood-plastic composite laminates (16).

More recently, the Redux process offers a method of bonding light alloys to themselves and to wood for use, among other things, as localized reinforcement to wood structures at points of concentrated stress (17). For bonding metals to metals and metals to other materials, the Cycleweld process is well known (18). Shear strengths of 950 p.s.i. have been reported for some of these adhesives in bonding metal to vertical grain birch, and values up to 3500 p.s.i. are indicated for aluminum to aluminum.

When the metal is to be bonded to a material with considerably different thermal characteristics, cold-press assemblies are often preferred, with perhaps a few localized hot spots to tack-weld the assembly during cure.

Rubber to metal in plastic laminates

Composite assemblies, involving rubber to metal or rubber to plastic composite laminates, have been popular for a number of years. The rubber is generally used when it is desirable that some shock or strain be absorbed which otherwise would be transmitted to the more rigid member of the assembly. Cyclizing rubber surfaces with cold concentrated acids is generally desirable in promoting a strong bond with a

TABLE II.—ALTERNATE CLOTH-CELLULOSE ACETATE LAMINATES

Cellulose acetate, per-cent	31	42	54	61
Over-all thickness, in.	0.049	0.050	0.062	0.072
Tensile strength, p.s.i.	4670	5500	5800	6970
Flexural strength, p.s.i.	3670	7200	7730	10,100
Modulus of elasticity (in flexure), p.s.i.	260,700	596,000	363,700	459,700

synthetic resin adhesive. D. S. Morse found that exposure of the rubber surface to actinic rays in the presence of vulcanizing agents helped in bonding the material to metal, glass or plastics (19). A thin flexible wood veneer reinforced with rubber has been manufactured (20) and the brass plating of aluminum to secure good adhesion to rubber is generally recognized (21). G. Proske has reviewed the general art of bonding rubber to metal (22).

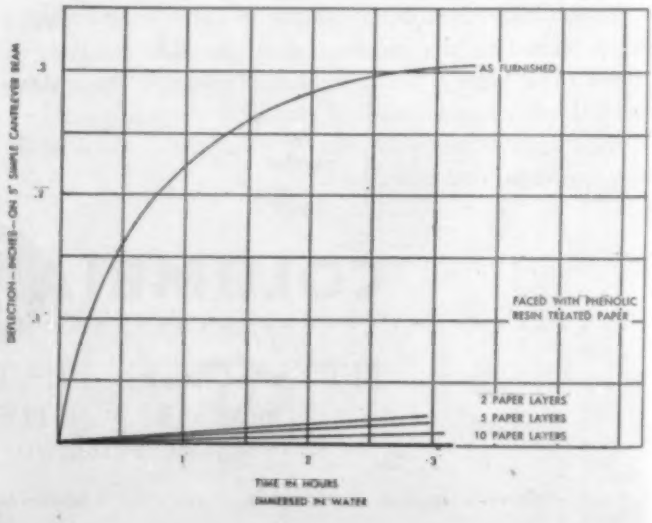
Most of the current metal bonding procedures can also effect bonds to rubber—a problem that has been quite important, especially in machine and product components involving installation of shock-absorbing systems. Another popular composite laminate has a wood veneer core with a vulcanized fibre sheet on one or both surfaces (23).

Composite laminates with transparent plastics

The lamination of photographs and identification cards between two sheets of transparent plastic have proved most popular. Obviously the principal advantage of the construction is that the laminate is well protected against grease, weather, water and wear.

A laminate of particular interest from the decorative angle is prepared with alternate layers of polymethyl methacrylate sheet and laminated phenolic. With this construction a bond is obtained that has greater shear strength than either material when used alone (Fig. 7). Another unusual composite laminate which has found extensive application in the B-29 bombing planes is assembled from acrylic sheets with a core of polyvinyl butyral (24). Much more shock resistant than straight acrylic, this laminate has the advantage of being, to a certain extent, self-sealing when penetrated by a bullet. In these and many other ways, plastic may be combined with other materials to bring out the optimum qualities of each. However, the successful preparation of compos-

8—*The rate of diffusion into the plywood may be seen from the initial slope of the time-deflection curves*



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You see above some typical post-war product parts—samples of plastic moldings—one in Saran—two with metal inserts in Styrene—others in different materials—for forward-looking Amos customers. The molds have been Amos-engineered and built—ready for fast production, when materials are available.

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ite laminates requires a knowledge of both the materials and the most effective adhesive agents.

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As the crow flies

(Continued from page 100) more now to assemble them than to produce the necessary parts. For instance, the use of metals in the cabin construction has meant the riveting together of many separate parts, wasting many man hours and adding greatly to production costs. Recent experiments have produced cabin sections of low-pressure molded, resin-impregnated glass-fiber laminates that have proved entirely satisfactory structurally and have reduced substantially the costs of assembly, the element of noise and, to a slight degree, the weight. Not only can cabins be so constructed, but the entire fuselage can be molded or formed instead of welded or riveted.

Advanced engineering is cutting operational costs. It has been determined that almost maximum power is needed for hovering or vertical ascent. With increased forward motion the required lifting power rapidly diminishes up to medium speeds. While the cost per mile of operation still exceeds that of automobile transportation, the helicopter, unlike a car, can move in a straight line between two points, thereby reducing the mileage. The end result is that from point to point, travel operational costs of the two vehicles are about on a par.

It is safe to say that the three factors upon which helicopter sales in the postwar era must be predicated—safety, easy operation and low cost of operation—will be solved. Helicopters will not replace the plane or automobile, they will not be made predominantly of plastics and they will not be as popular as the old "Model T," but their sales will run into many millions of dollars. First uses will undoubtedly be for commercial purposes rather than for pleasure. But in time the helicopters will become a quite matter-of-fact mode of transportation.

Propeller brush holder

(Continued from page 142) tributed valuable assistance throughout the design and development program. Late in 1940, as soon as tests of the machined pieces had proved the worth of the design, they proceeded with the fabrication of the first molds—one cavity each for the block and cover. These were of the hand-transfer type. Using these molds and Navy Type C.F.G. material, the first parts were molded on December 12, 1940.

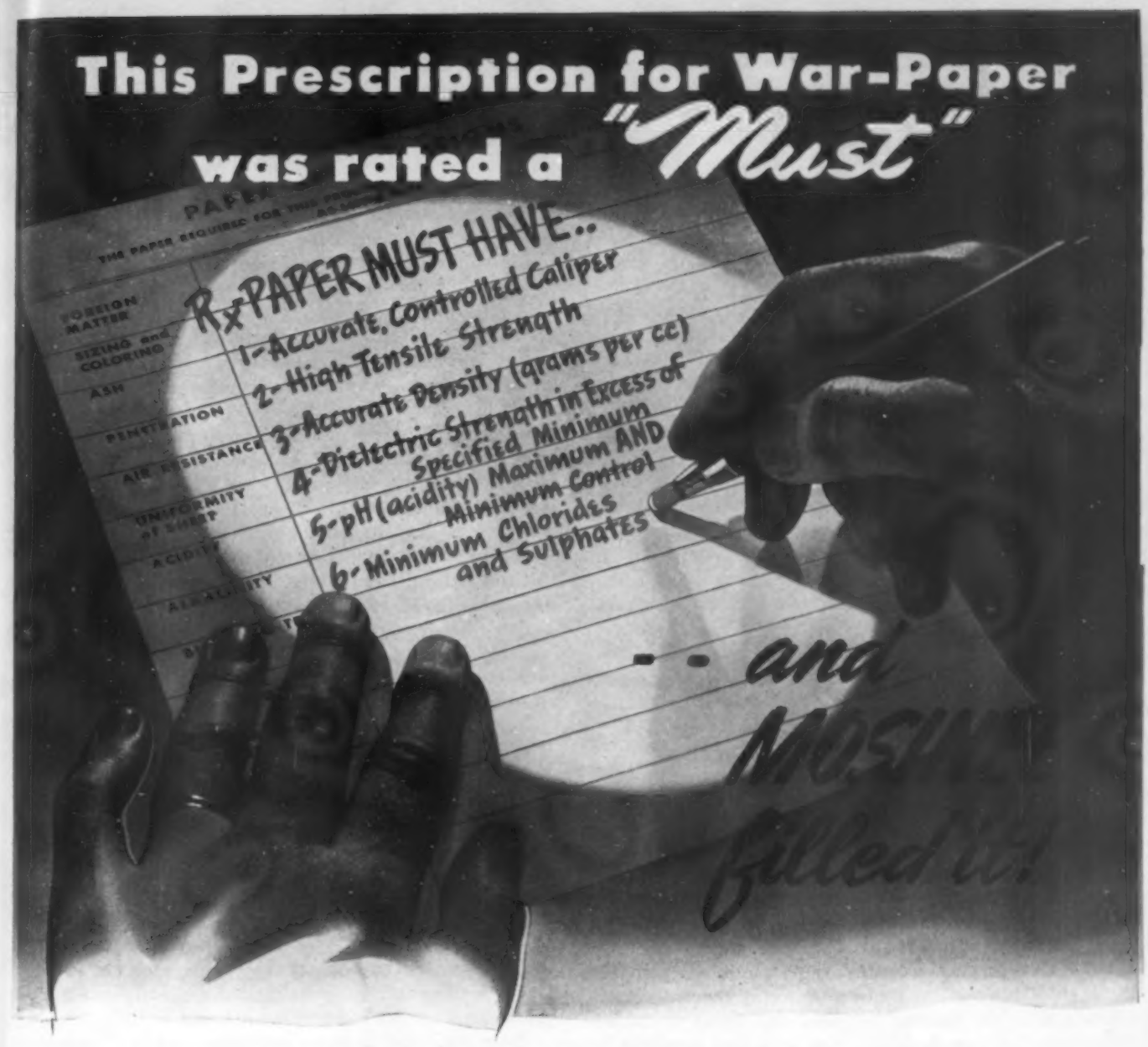
Subsequent laboratory and flight testing on these molded parts indicated a need for a minor design change in the block in order to avoid a stress concentration at the mounting holes. Testing also proved that a high-impact material was required if the parts were to withstand the severe vibratory loads imposed. Consequently, an intensive program was instituted to develop the molding technique to permit the use of such materials. This development progressed through the molding and testing of several medium impact materials. During this time it was found that if warping was to be avoided as the piece cooled, it would be necessary to change the design of the connector strip inserts in the molded cover. These brass strip inserts (Fig. 4) were soldered to a terminal block which was located in the center of the cover. Originally the ends of the strips were turned upward and embedded in the molded material. However, the differential shrinkage rates of the molding compound and the brass strips caused the brass strips to be placed in compression which in turn caused the cover to have a tendency to flatten out or warp. The trouble was eliminated by cutting off the turned up ends of the insert strips so that the strip was anchored only to the terminal block at its center. This modification permitted the molding compound to shrink under the inserts without causing distortion. The connector strips were formed with a smaller radius of curvature than the mating portion of the mold so that when the center of the strip at the attached terminal block was held down in the mold, the spring tension held the ends tightly against the mold surface.

With this development completed, the molding technique seemed suitable for production use and thorough testing indicated that a successful functional design had been evolved. Therefore, quantity production of the block and cover shown in Fig. 4 was begun during 1941 in time to meet the requirements of the war production program.

The next concern to undertake the production of these parts was Mechanical Institute. This company turned out the pieces from compression-type molds and many satisfactory parts were produced during the early part of the war. However, this method of molding proved to be relatively slow and the spoilage rate rather high because of distortion of the brush guide tube inserts and breakage of the mold pins locating them. The axis of the force was perpendicular to the plane of the tubes so that the tendency always was to crush one row on the next. These molds were replaced by a transfer type.

As production requirements continued to soar, other sources for these parts were brought into production. The concerns include the Plastics Divisions, General Electric Co., Watertown Manufacturing Co., Plastics Manufacturers, Inc.

More recently, the growing use of the reverse-pitch function of the propeller made a separate reverse-pitch circuit imperative. This need led to the development of the six-row brush holder shown in Fig. 5. The second row that was added was to allow for radio interference bonding. The one-piece molded cover (Figs. 6 and 7) was developed as a part of this holder and



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The paper part of the product proved to be the cause of the failure. Proper adjustment in processing the paper, re-writing of the prescription and establishment of proper controls to attain the maximum limit of one of the ingredients (formerly ignored), prevented further failures. MOSINEE thus made another valuable contribution to the war effort.

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resulted in considerable simplification of the brush assembly by permitting the attachment of the electrical leads directly to the cover. The cover and block each incorporate two serrated steel insert blocks which, with the elongated mounting holes in the block, permit selective positioning of the brush holder with respect to the cover. This feature provides for adjustable location of the brushes on the slip rings in order to compensate for misalignment due to tolerances. Previously this compensation had to be accomplished by shims between the propeller and its locating shoulder on the engine shaft.

This six-row cover was originally produced by the Synthane Corp. and subsequently by two of the molders mentioned previously. This part is molded from medium-impact rather than the high-impact material from which all of the other pieces are made. The latter material proved impractical with the rather intricate and relatively fragile inserts required to connect the prongs on one side of the piece with the connector strips on the other side.

Although all of these parts present obvious molding difficulties, production and quality control practices have been worked out which permit rapid production and assure airworthy parts. One important contribution to the success of the production program was the development of high-frequency preheating of the molding preforms. Prior to this development a 30-min. cure was required on the blocks to minimize warpage. With standard infrared preheating, 15 min. of curing time and 2 min. for pot closing were necessary. However, when the preforms were preheated between the electrodes of a 5-kw. high-frequency oscillator for a period of 40 sec., the molder discovered that the pot closing time could be cut to 10 sec. and the curing time to 2 minutes. This preheating practice not only greatly increased production capacity but improved quality by reducing warpage.

One problem in the production of these parts is the necessity for close mechanical tolerance control as shown by Fig. 8. The tolerances that are specified provide for proper assembly of all mating parts and assure complete interchangeability. Time has proved that these tolerances are practical and obtainable on a production basis. The accurate sizing of the brush guide tubes is obtained by broaching the tubes after molding since the molding pressures were found to distort the relatively thin wall tubes. This broaching operation is set up to remove only a few thousandths of material, but it performs the difficult task of removing flash from the tubes.

After molding, both the blocks and the covers are checked for proper dielectric strength by applying a 1200 volt, 60 cycle, a. c. potential to the various adjacent inserts for a period of 60 sec. each, or by the use of 1440 volts for a period of one second. Any insulation breakdown under this test is considered to be cause for rejection.

After thorough removal of flash and burrs by buffing, the exposed portions of all the cover inserts are silver plated by immersing the complete molded cover in the plating solution. The molded blocks receive no plating, but the concave surface is ground to an accurate radius and a specified over-all block thickness. This grinding assures the removal of all flash—which might otherwise chip off later on—from the ends of the tubes and provides an accurately positioned surface to which a 0.010 in. thick coat of arc-resistant varnish is applied. This varnish is applied by spraying, but the specified thickness must be maintained to assure real arc-resistance. The preparatory grinding permits accurate measurements before and after varnishing to check the varnish thickness.

This varnish is used to minimize damage to the insulating properties of the molded block from the heat of arcs which occasionally occurs through the coating of oil and carbon dust which collects on the face of the block. Such an arc burns the oil and dust away in a matter of seconds and will thus quench itself if the block surface is sufficiently heat resistant to avoid carbonizing under the arc. The phenolic materials used, however, are not sufficiently heat resistant and, unless protected in some manner, will carbonize, thus providing a permanent short circuit path for the arc and destroying the usefulness of the block. Use of the arc-resistant varnish permits the block to stand repeated arc flash-overs without damage and has the secondary function of providing an insulating coating over the ends of the brush guide tubes, thus increasing the effective length of air gap between circuits.

The necessity for the use of this varnish reflects one of the principal limitations of present-day phenol-formaldehyde materials. The present molded brush holders made from these materials have, however, proved eminently successful in the toughest of all proving grounds—the far-flung combat areas of our Air Forces.

TABLE I.—AMOUNT OF MATERIAL USED PER PIECE

Part	*Material*	*Material required per piece*	*Weight of finished part*
		gm.	*lb.*
4 row block	BM 3510[a]	325	0.91
4 row cover	BM 3510[a]	135	0.31
6 row block	BM 3510[a]	450	1.34
6 row cover	BM 1132	544	1.18

[a] Or Textolite #1379.

A basis for judgment

(*Continued from page 109*) an orange, the nose a light color and the hair around the eyes a lighter shade of the same color used for the body of the animal. After much trial and error, when paint that matched a color swatch was found to turn another shade when it dried on the plastic models, the problems seem now to have been solved.

Even before the Guernsey model was considered, a series of experimental models were made from photographs and wooden reproductions, in which the best features of various animals

4—This underside view of the model Guernsey shows the excellent proportions maintained in the reproduction

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were combined. Finally, at a meeting of the Holstein-Friesian Association, a much-revised miniature received official approval.

Immediately work was started on a Jersey model cow, but this time the trial and error steps were passed over. Using seven different animals the wooden model received instant approval from the Jersey Cattle Club. Then came the Guernsey model.

Credits—Material: Tenite II. Molded by Elmer E. Mills for Montgomery Ward and Co.

Silicone formulations

(*Continued from page 113*) prepared and studied a great variety of such materials. Their findings are reported in fifty-one papers published by the Chemical Society.

At first, chemists were curious to see what would happen to the familiar organic compounds if some of the carbon atoms were replaced by silicon. More recently, however, the emphasis has shifted from the substitution of silicon in organic compounds to the substitution of organic groups in silicon oxides and halides. That is, instead of inserting a silicon atom in a predominantly organic structure (where it produces only a small but orderly change), organic groups are being inserted in predominantly inorganic silicon oxides (where they cause a great change in the properties of the substance).

The first experimental work that was carried on in this field had as its objective the development of high-heat resistant resins as impregnants and binders for inorganic fibrous materials. It was hoped that a composite insulation could be discovered which could allow electrical equipment to operate at temperatures far above the limit imposed by organic insulation.

Today, this objective seems to have been reached, in part at least. Whereas glass-cloth impregnated with an ordinary insulating resin cannot withstand a temperature in excess of 260° F., identical glass-cloth impregnated with silicone resin can be safely subjected to temperatures of from 300 to 480° F. and coupled with this high head-resistant quality, silicones possess a remarkably low power factor at high temperatures. Silicone resin impregnated glass-cloth, 6 mils in thickness, has a dielectric strength of 1600 volts per mil. When this same strip of insulating material is reverse creased and then tested, the dielectric strength is 500 volts per mil. This figure after reverse creasing compares with a dielectric strength of 100 volts per mil for material impregnated with previously available resins.

Just how much a motor can be stepped up because of the ability of the silicone-impregnated insulating material to withstand heat, is limited in actual practice by several factors. For instance, the copper conductors oxidize quite rapidly in the neighborhood of 400° F. This problem has been solved at least in part by coating the copper with a more highly oxidation-resistant metal. A suitable lubricant for motor bearings, operating at high temperatures is a necessity. Such lubricants—silicones—are now in the development stage. With present motor design the efficiency of the motor is reduced to some extent when operating at these temperatures. Future motors should be specially designed for high-temperature operation.

In addition to its use as an impregnant for insulating tape, silicone resin is employed to laminate various thicknesses of glass cloth which find their way into panel boards aboard ship and into airplane instrument panels. Some work has been done with the resin as the impregnant for kraft paper intended for use in condensers. Silicone resins are also used as paint vehicles—the product being similar to the synthetic enamels that now are used on stoves. However, silicone resins have the special advantage of withstanding high temperatures over extended periods of time without changing color, of being highly resistant to the effects of various acid and caustic solutions, and of withstanding severe blows without chipping. The use of these silicone resins in molding is still in the experimental stage.

Perhaps one of the most interesting and unexpected discoveries to come out of the laboratory work in the field of organo-silicon research is that the action of various organo-silicon halides on glass, paper and cotton surfaces will render these surfaces water repellent to a high degree.[4] Mere exposure of the surface of these materials to the vapor of methyl chlorosilanes suffices to impart a water-repellent film which withstands washing, dry cleaning and some abrasion. Usually a certain amount of moisture must be present on the surface that is being treated. The chlorosilanes are hydrolyzed by the water on the surface forming silicones which adhere tightly to the surface. Alternatively, material that is to be made water repellent may be dipped in a liquid containing methyl chlorosilanes.

At present, this silicone formulation is finding extensive use as a coating for radio ceramic coil forms. When planes descend from high altitudes, vapor condenses on the forms, impairing their operation. Formerly, these ceramic coil forms were given a wax coating to increase their water repellency, but the wax was not as permanent and the life of the treatment was not as satisfactory. Tests have indicated that a silicone film on these ceramic coils is six times as effective as the wax in overcoming the effects of moisture condensation. The film is also being used on transparent surfaces and as a treatment for filter paper where it permits the passage of oil but holds back the water.

In the course of further research on organo-silicon materials, it was found possible to make silicone oils which not only had the stability at high temperature which is characteristic of silicones but also remained fluid at very low temperatures. In fact, the change of viscosity with temperature is so much less than that of ordinary petroleum oils that a single silicone oil often will suffice for operation of equipment from −100 to 400° F. These silicone oils do not swell natural rubber nor corrode metals, and their low power losses makes them useful also as electrical insulators.

While only a few practical applications of silicone formulations have been made thus far, present research suggests a number of possible future uses for these materials.

Silicone rubber—In the printing industry where hot-melt inks are used, silicone rubber rolls should provide outstanding improvements over natural or synthetic rubber rolls by virtue of the high heat resistance of these new materials.

Even now silicone rubber covered wires have been produced on an experimental basis. As time goes on and more of this material is available, it should find application in hose connections, as tubing for the transfer of high-temperature liquids, as rubber gloves, bushings and covering for cables. It may well be used by cleaning shops on their steam pressers.

The chemical industry with its countless high-temperature reactions using equipment involving gaskets will, no doubt, be interested in gaskets made of silicone rubber because of their lack of compression set at high temperatures.

Silicone resins—Enamels made from silicone resins should be popular as baking enamels for refrigerators, ranges, roast-

[4] Dri-film, trade mark of General Electric Co.

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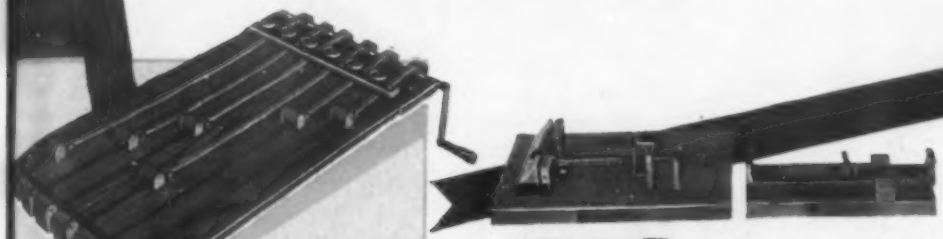

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CRESCENT TEAR TEST JIG
Used for slitting the crescent tear test pieces according to A.S.T.M. D-624. The slitting depth gage on the right also furnished.

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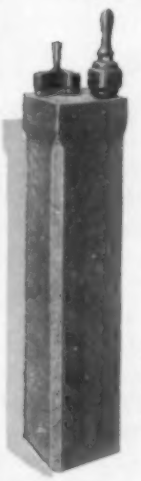

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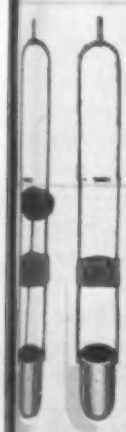

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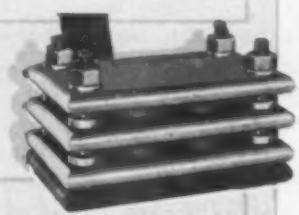

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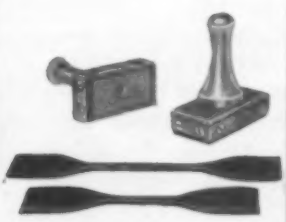

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ers, for radiators, ducts, heat exhaust pipes and for stacks.

The resins will undoubtedly be used for laminates of all types. Their use in molding is still unrevealed.

Dri-film—Treatment of textiles with chlorosilanes to render the surface water repellent should have wide postwar use. Experimental work carried out along these lines indicates that dry cleaning does not affect the treatment. After the garment is cleaned and dried, it still is water repellent. After washing, the soap must be thoroughly removed.

This liquid or vapor treatment can also be used on windows and mirrors, for automobile windshields and similar applications. Experimentally it has been applied to wallpaper to make it more easily washable.

If the inside of a glass is coated with this solution, water will not cling to the inside as it would under normal conditions. Instead the top surface of the liquid will be perfectly flat. This behavior can be used to advantage in all types of testing gages for there will be no question of the exact height of the liquid in the tube as the top surface of this liquid is absolutely flat.

Undoubtedly many of the most interesting uses to which these various types of silicone formulations are being put will continue unrevealed until the end of the war. However, the very fact that the entire output of all these materials goes to applications of the highest essentiality, confirms their importance.

Acknowledgments

We wish to thank Dr. A. L. Marshall, Dr. J. Marsden, Dr. F. L. Norton, Mr. C. S. Ferguson, Mr. W. T. Eveleth and others of the General Electric Co. for their assistance in the gathering of the material and the writing of this article.

A new frontier

(*Continued from page 107*) once it was molded and that would accept the shape of the original mold with true fidelity, was something often dreamed of but never before actually produced. C. F. Kettering made full use of this resinoid in the automobile industry, and today the modern automobile runs smoothly because its electrical system is protected with plastics throughout. It runs silently because of silent phenolic timing gears, safely because of plastic bonded brake linings and laminated safety glass.

Early in his work, Doctor Baekeland recognized the possibility of mixing abrasive grains with these new resinoids, and in 1909 a patent was issued to him for that purpose. However, it was not until 1921 that abrasives bonded with resinoid became commercially practical.

In the field of communications the Doctor's resinoid was in use by 1915. Radio accepted it as a must for the material possessed the essential characteristics required for radio service. It appeared as laminated panels, molded dials and sockets, coil forms, and similar parts. And, as the radio industry mushroomed, use by radio manufacturers increased.

Use of the specific plastic developed by Doctor Baekeland has spread amazingly. Here, today, almost thirty years after it first poured forth from the Doctor's kettles, it still stands at the top of the tonnage list. The Doctor's work should be given credit for the impetus it gave to the whole plastics development during recent years. He showed the demand that could be built up around a product that few people thought had any uses in the early part of the century, he showed the methods by which the job could be approached and the rewards that awaited anyone who could drive through to his chosen goal.

Blow molding

(*Continued from page 133*)

Bottles have been successfully made from cellulose acetate, cellulose acetate butyrate, ethyl cellulose, polyethylene and polystyrene. Other articles which pass through the machine with a somewhat different sequence are those in which air under pressure is permanently sealed in them for the purpose of forcing the articles to hold their shape.

A Christmas tree ball, for example, to compete with glass Christmas tree balls, must sell at a very low price. Since the cost of the plastic is in the neighborhood of 50 times the cost of glass, the plastic balls must be made very thin in order to meet the price competition. Without interior air pressure such balls could not be packed or handled without going completely out of shape. A wall of the order of 0.008 to 0.015 in. on a $2^1/_4$-in. D. ball has very little stiffness. These balls were, therefore, made with a 4-lb. interior air pressure which forced them back into shape even though they became dented when, for example, they were stepped upon. Some balls made four years ago with a sealed-in air pressure of 4 p.s.i. still contain pressures as high as $2^1/_2$ p.s.i. and appear to be holding constant at this pressure. These balls are made by extruding a small tube about $^7/_{16}$ in. D. which is slightly longer than the diameter of the ball, plus the height of the eye. When the mold halves close about this extrusion, they pinch the bottom, thus preventing the plastic from blowing out at this point. They also pinch out a portion of the neck, finally leaving a round tube about $^3/_8$ in. D. through which the high air pressure is forced into the ball.

During this time, the head of the extrusion machine is so close to the mold that the soft plastic can seal the crack sufficiently to prevent air from escaping. Each mold half bears a cylindrically shaped rod which is finished off at the end so that when these meet they form the eye of the Christmas tree ball, and very nearly squeeze out the plastic both at the inside and the outside of the portion which subsequently forms the eye. Plastic coming from the center is squeezed into a hole having a spring-retained plunger. Here the excess plastic freezes to form a small plug which is forced back into the eye hole of the Christmas tree ball in a loosely held condition when the mold opens. The plastic is thin and it freezes very rapidly in contact with the cold mold.

The pinchers are held together to back up the thick parts of the plastic until the mold opens at the ejection position. Since the air pressure is sealed into the ball at the forming position, it is not necessary to use a blowing head during any other part of the cycle. While rates as high as 33 Christmas tree balls per minute were obtained in experimental runs, it was found that the mechanical construction of the machine would not permit rates higher than 28 per minute to be sustained over long periods of time.

When the Christmas tree ball leaves the machine, it has a flash around the eye portion and also a small plug of plastic in the hole of the eye as previously referred to. It also has flash at the lower end where the extrusion was pinched in the bottom of the mold. These flashes are subsequently removed in a semi-automatic machine.

Toilet floats and other closed articles are made in a similar manner. The different parts must, of course, be designed to form the required sequence of operations.

Limitations in use

One very naturally jumps to the conclusion that, since there are hundreds of millions of glass bottles sold in the United

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States every year, there must also be a place for at least tens of millions of plastic bottles. When thinking of this comparison, one must remember that glass is a very cheap material, the ingredients of which cost from $7.00 to $15.00 a ton and which in the commercial grades usually used for bottles can be delivered to the forming machines at a price, including all melting operations, of $15.00 per ton. Moreover, it is substantially immune to the attack of all ordinary foods and chemicals except chemicals containing hydrofluoric acid, it does not permit migration of air or water through its wall, it does not impart taste or odor to its contents and, when filled with liquid and dropped upon a wooden floor or a floor covered with any sort of carpeting material, it will withstand a shock at least as great as, and often greater than, will thin bottles made from many of the plastic materials.

Nevertheless, the virtues of the plastic bottle are such that it can and will be used for special applications in which its properties are of advantage. For example, polystyrene bottles may be used to contain and convey hydrofluoric acid and hydrofluoric acid-bearing compounds. Mixtures consisting of oil emulsions may be packed in certain plastic containers. All dry compounds such as talcum powder or any dry material which is not especially hygroscopic can be packed in plastic containers. Cosmetic bottles are made from the tough plastics that are immune to breakage by dropping in the bathroom or on to tile floors. Plastic bottles are also light and have an esthetic appeal which the glass bottle in its ordinary form does not have. The fields in which blown plastic articles have so far proved successful include:

1) Any form of container made from plastic sheet.

2) Bottles used as containers for small instrument parts such as small screws, bolts and nuts. Here their transparency, toughness and the security of their top make an ideal application.

3) Toilet floats made from cellulose acetate or cellulose acetate butyrate have withstood service for a number of years and seem to be, in all respects, equal to the more common copper float.

4) Salt cellars, molded cases, ornaments, toys and trinkets furnish a lucrative postwar market.

Economics

At the present time, not much can be said regarding the ultimate cost of blown plastic containers. This is partly because so much depends on the price of molding powder. As a general rule, based upon the present costs, plastic bottles, with the same content capacity as glass bottles without caps, will run from four to nine times the cost of a comparable glass bottle, this variation in cost being determined by wall thickness.

Adhesives

(Continued from page 126) bonding as described above, the cellulose acetate is easily distorted by the mild heat and pressure required in the assembly. The limitations of the plastic itself call for a more involved bonding technique.

The final answer in this case was found in baking a solvent-type adhesive on the metal. Thereafter, the bonding of the two sheets is accomplished with a second adhesive that requires no solvent elimination or elevated temperature for its cure. The second adhesive is simply applied to both surfaces which are then pressed together.

Since these techniques are as new or newer than the plastic adhesives themselves, it is frequently necessary to dispatch an engineer from the staff of the adhesive manufacturer to supervise the establishment of these adhesives as a regular production tool. Almost invariably his services are devoted to convincing the plant's personnel of the necessity of following the previously established bonding procedure *exactly* and not merely *approximately*.

When properly used, plastic adhesives can provide bonds of extraordinary strength, often exceeding that of the bonded materials themselves. This optimum result, however, is usually achieved only after the gap between the research laboratory and commercial production is bridged.

Material analysis

(Continued from page 102) sure-sensitive adhesive tape for military packaging, goggle lenses, gasmask parts, rocket parts, flashlights, toothbrushes, and Army bugles and whistles.

Considerable difficulty is being experienced in this field due to exceedingly critical supplies of plasticizers, the direct result of other competing demands for raw materials—the insectifuge and smokeless powder programs for instance. Acetic anhydride, of which 439 million pounds are needed for the production of the estimated 309 million pounds of flake, has been in short supply for several months, as have the phthalates. No relief is foreseen for either for an extended period. In fact, increases in the smokeless powder program may drain off some of the cotton now being consumed by this industry.

Good figures are not available (and probably could not be used if they were) for nitrocellulose for smokeless powder, dynamite, lacquers and film. Although the nitrocellulose plastics production rate has been much higher in the past, limited supplies of synthetic camphor are keeping the output at about the 12 million pound level. Camphor relief should come with V-E Day but, until that time, there is little hope for any large production of this material for uses other than military items, corrective spectacle frames, fountain pen and mechanical pencil barrels, and ladies' wood shoe covers.

Ethyl cellulose, with two producers, is operating at a rate of less than 12 million pounds, although additional facilities are being readied to take care of the heavy demands for rocket parts, classified war items, lacquers, the well-known "strip-coat" type of military packaging, Army flashlights and many similar products.

Polystyrene

Benzene availability continues to govern the polystyrene distribution pattern. Its consumption matches approximately pound-for-pound the 9 million-pound production rate of polystyrene. Competitors for this benzene are aviation gasoline additives, synthetic rubber and similar products. In the main, current use of polystyrene is based upon this material's unusual characteristics of low moisture absorption, excellent electrical properties and resistance to nearly all types of acids. Prominent among the products being turned out are caps for nitric acid bottles and carboys, electrical coil forms, toilet tank floats, bottles for hydrofluoric acid (replacing the dangerous wax bottles), shoe adhesives, caustic tank car linings, cotton-like batts of fiber for rubber-bag molding of low density parts, and foam for flotation units to replace critical cork and scarce balsa. Production will probably remain at about the present level, although it is not impossible that further raw material limitations may reduce output.

Casein

Rennet casein plastics are currently at a 6 million pound level, the output going principally to buttons. The coagulant

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is the natural enzyme found in the fourth stomach of a calf, but the number of calves required as raw material cannot be easily determined.

Acrylic resins

With two major producers, the acrylics, used here as a generic term for both acrylates and methacrylates, are now well over the 35 million pound level. While the aircraft industry is the major customer, large quantities go for Navy glazing, instrument lenses, dentures, surgical instruments, precision drafting instruments, leather finishes, chemically resistant protective coatings and specialty adhesives.

Production has been held down for the past year by the limited quantities of sodium cyanide available, its use in acrylic competing against the demand for cyanide for metal plating and case hardening, and for metallic sodium to be used in the manufacture of tetra-ethyl lead. New sources of cyanide should bring about some relaxation in the strict allocation policy within the next several months. However, another essential raw material (which cannot be mentioned at this time) is rapidly approaching the point where it may become the controlling factor in the acrylic production picture.

Polyethylene

Polyethylene, with only two producers, is now operating considerably in excess of 9 million pounds. The major, in fact the only, use of this material is in electrical insulation.

Coumarone-indene resins

Production of coumarone-indene resins has dropped somewhat below the 35 million pound mark, due partially to the poorer quality of crude solvent naphtha obtainable for its manufacture. As coke ovens approach and pass 100 percent of their design capacity, the polymerizable content of the fractions falls off seriously. Because of the important military and industrial uses requiring this material—anti-fouling ship-bottom paint, for example, or aluminum paint for gasoline and chemical storage tanks, refinishing compounds for Army tentage, and synthetic rubber plasticizers—such purely civilian uses as floor tile, fly paper and chewing gum have suffered a real hardship.

Allyl resins

With but one manufacturer, the resins derived from allyl alcohol have a somewhat limited production. The cast sheets are comparable to the acrylics in transparency, superior in surface hardness, and inferior in impact strength and formability. Use of these resins has been confined almost exclusively to military outlets because of the limited availability of the other raw materials, besides allyl alcohol, that are needed for their production.

Polyester resins

The class of resins upon which most "contact" laminating processes are based is commonly referred to as polyesters. Formulated with styrene, phthalic and maleic anhydride, with a dash of allyl alcohol, these resins are still so new that the half-dozen producers are very reticent about discussing raw materials. Inasmuch as the bulk of the applications are of a military nature, there is little that can be said regarding end uses, except that many of the parts actually in production are surprisingly large and complicated.

Vinyl resins

To avoid disclosure of competitive information, it is necessary to aggregate polyvinyl acetate, polyvinyl chloride, polyvinyl acetate-chloride copolymers, polyvinyl acetals and polyvinylidene chloride. Totalled, their production reaches 120 million pounds. This represents an intake of about 65 million pounds of acetylene and ethylene (expressed on the acetylene basis), 46 million pounds of vinyl acetate monomer, 41 million pounds of hydrochloric acid and chlorine, 5 million pounds of aldehydes, and about 6 million pounds of "indirect" raw materials, such as methanol and benzene.

Of the 120 million-pound total, about 110 million pounds are used for flexible film in military packaging and in covers for firearms, for fabric treatment, safety glass, wire and cable insulation, and cements and adhesives. A considerable portion of the balance goes to rigid sheets and moldings.

Statistics, what they mean

The January 25th bulletin of Arthur D. Little, Inc., presents the following figures as a summation of production in the plastics industry:

	Pounds per month
Phenolic molding powders	10,000,000
Urea and melamine molding powders	3,000,000
Cellulosic molding powders	5,500,000
Laminates	6,700,000
Total	25,200,000

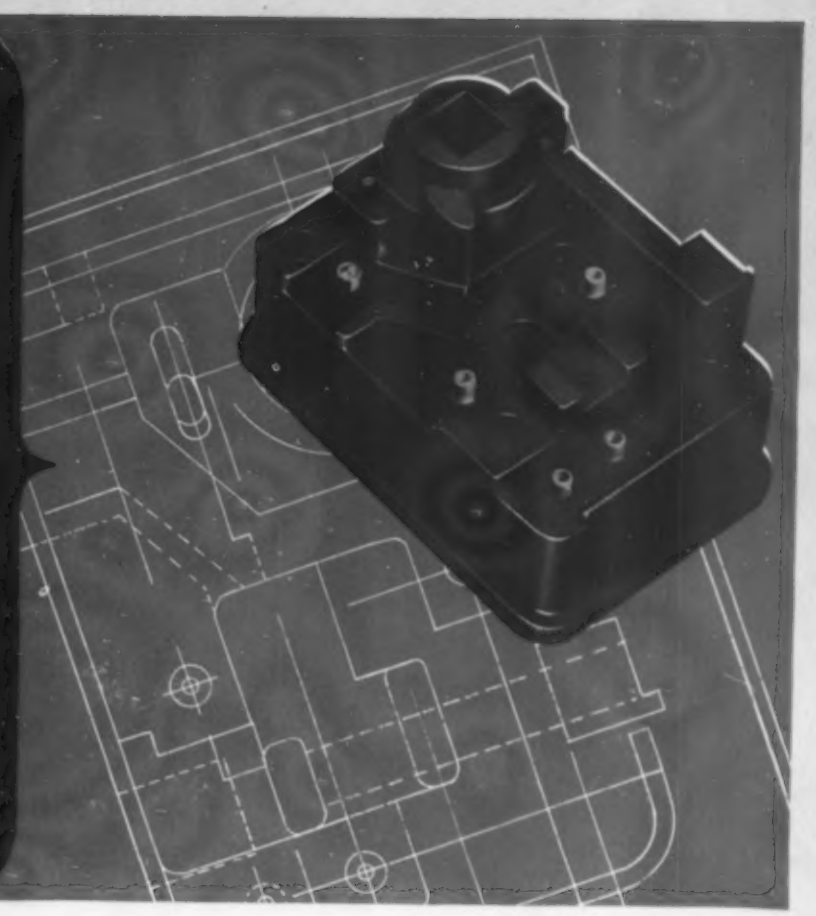
This monthly total of 25 million pounds represents an annual rate of 302 million pounds. There is, however, more to the plastics industry than the three molding powders and the laminates tabulated by Mr. Little's organization. Similarly, there are numerous ramifications which are not touched upon in this article. Hence, the data presented herein should be used thoughtfully to avoid misinterpretation or misuse.

The postwar picture

A summation of the individual material figures gives a total of about 790 million pounds as the annual rate of production for all major classes of plastics and resins. Of this, approximately 413 million pounds may be considered as structural or rigid plastics. These are the plastics which, we are told, will find themselves in competition with light metals in the postwar period. In some isolated cases, there may be some competition. It will, however, be only temporary, and each material will ultimately find its own sphere of usefulness. Wise designers will take advantage of the divergent physical and chemical properties of metals and plastics, and will combine them so that they are complementary instead of competitive. The utter futility of competition can be established by comparing 2 *billion* pounds of aluminum or about 178 *billion* pounds of steel ingots with 413 *million* pounds of rigid plastics. The plastics production is only 21 percent as great as that of the aluminum and 0.2 percent that of steel.

While the postwar plastics situation would appear to be very good, it is of the utmost importance that the industry keep at least one foot on the ground. We all realize that the readers of the Sunday supplements are eagerly awaiting plastic houses, plastic automobiles and plastic airplanes. This phase, however, should cause little trouble for we also realize that such things are not within the realm of present-day possibilities. Smaller, less sensational products can be the source of even more embarrassment to the industry if, in a desire to rush items onto the market, processors do not see that they are properly engineered and the correct material selected. Responsibility in this matter rests equally with the material manufacturer and the molder or fabricator.

WE READ BETWEEN THE BLUEPRINT LINES



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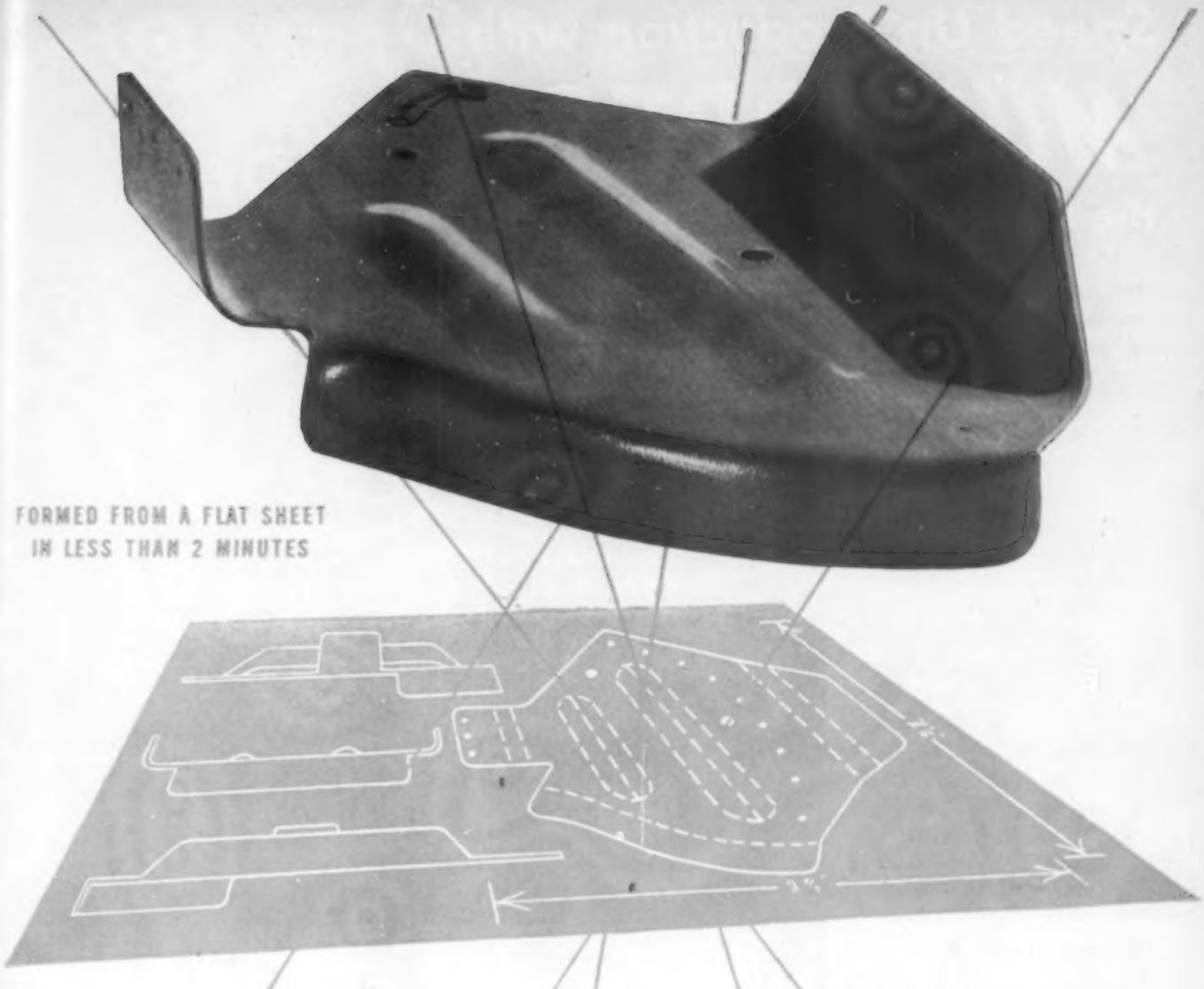

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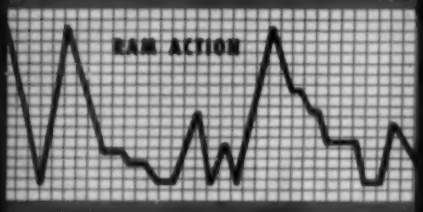

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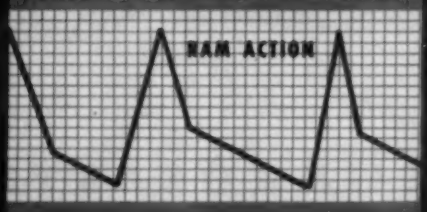

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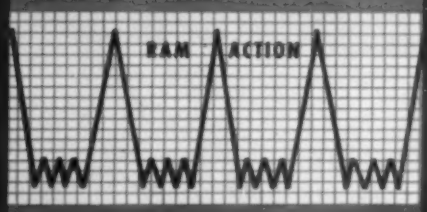

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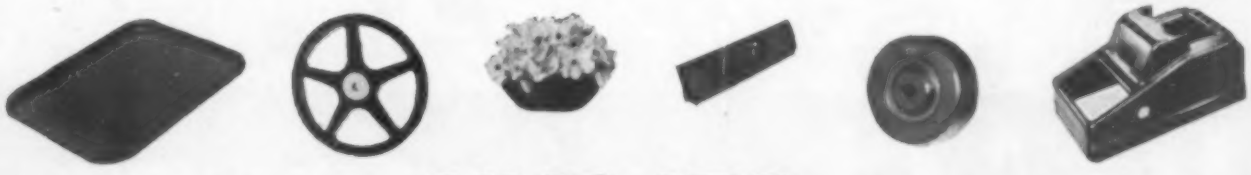

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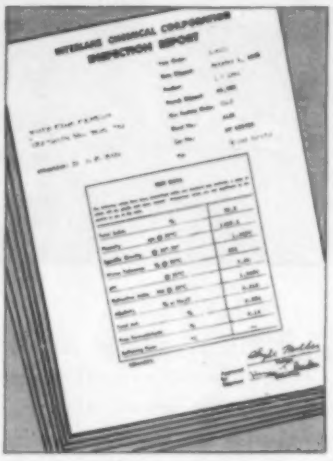


▪ The extremely close range of variation within which Interlake Specification Resins are held is evidenced by a control laboratory inspection report—*with each shipment*—showing complete chemical characteristics of the resin.

Multi-purpose resins are now outdated by resins functionally precisionized to do one specific job with maximum efficiency and dependable uniformity.

EVERY RESIN job today is properly a specification job—because now we successfully vary the chemical constituents of phenolic resins—in an almost *infinite* number of combinations—and produce resin properties precisely fitted to *any one* of an extremely wide range of applications.

Furthermore, with exacting laboratory control of production, we so stabilize each specification resin that the performance of every shipment delivered is identical with every other.

These now are commonplace facts, proved day in and day out by users of Interlake Specification Resins in a score of industries where the efficiency and uniform performance of Interlake Specification Resins are improving products, speeding production and cutting costs.

To get *better* and *uniform* results from a resin, *use a stabilized specification resin.* Interlake will gladly develop one for you.

* * *

IF YOU HAVE A RESIN PROBLEM, draw freely upon the wide experience of Interlake. We will gladly work with you on any resin problem, or discuss with you the possible advantage of using resins in any operation or process. Write Interlake Chemical Corporation, Plastics Division, Dept. 13, Union Commerce Building, Cleveland 14, Ohio

Interlake Production-Stabilized Resins have been developed to precise requirements of many specific applications in coating, impregnating, bonding of...

WOOD • PAPER • METAL • GLASS
FIBRE • RUBBER • CELLULOSE

INTERLAKE CHEMICAL Corporation

PLASTICS DIVISION

Specificity IN RESINS

FILE IT

"AGAINST" THE EDGE —NOT "OFF"

LAMINATED PLASTICS. The use of thermoplastic-bonded laminations of paper, wood and plywood has created finishing and fitting problems quite distinct from those in solid-molded plastic products.

Edges and corners of sawed sheets—notches and drilled holes—die-formed bevels and edge-beads . . . all call for smoothing operations that do not spring, separate or "fuzz" the laminations. They must deal with both fibrous and plastic materials.

Since filing is usually the best method, selecting *The right file for the job* is important.

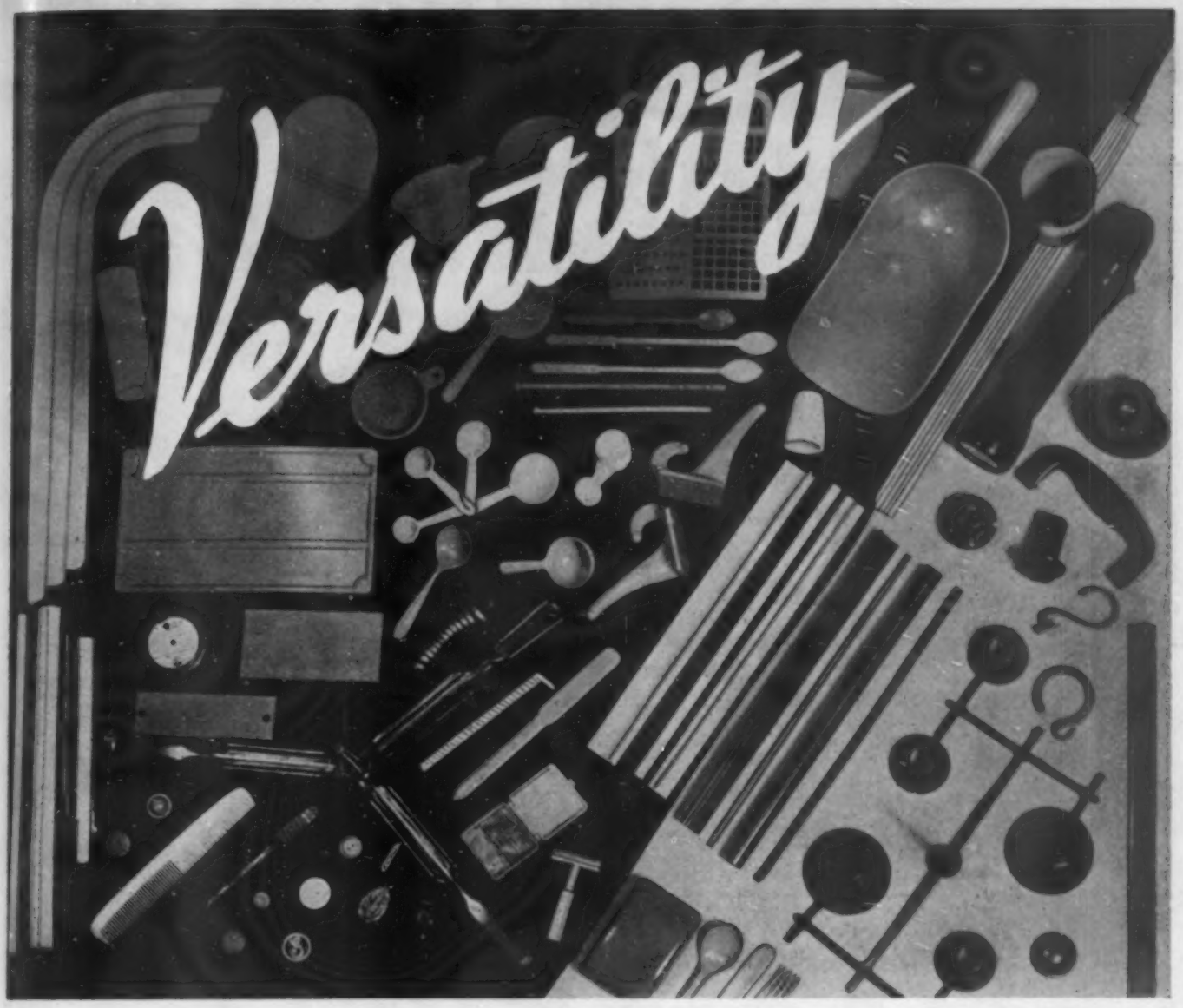
In the demonstrating actions above, a Nicholson Mill Bastard File is used. The results of correct and incorrect use are apparent—no ragged finish and no danger of separations when stroked "against" instead of "off" the edge.

Various types of Nicholson Files are available for different types of plastics. Fundamentally, the important characteristics are: Wide gullets, to minimize clogging; and thin-topped teeth, to combat the abrasive action of certain thermoplastics, and to maintain sharp cutting edges longer.

You can be sure of the correctness of all files Nicholson endorses "For Plastics." Consult us any time—through your mill-supply house or direct.

NICHOLSON FILE CO. • 44 ACORN STREET, PROVIDENCE 1, RHODE ISLAND
(In Canada, Port Hope, Ont.)

NICHOLSON FILES FOR EVERY PURPOSE NICHOLSON U.S.A.



Chemaco Cellulose Acetate

High Acetyl Cellulose Acetate, formulated by Chemaco has exceptional versatility in meeting rigid military and industrial specifications, as well as in forming a multitude of civilian items.

While it has the toughness, color and lustrous finish of standard Chemaco Cellulose Acetate, it has additional fine properties which add to its general utility. The dimensional stability is considerably improved because of increased resistance to heat and moisture. Like standard cellulose acetate it can be formulated to be tasteless, odorless and non-toxic.

Both standard and high acetyl cellulose acetate are available in all colors and in an unusually brilliant crystal. The colors may be obtained in transparent, translucent and opaque shades. Chemaco Cellulose Acetate lends itself to a vast variety of uses from trims and edgings in extruded form to flashlight cases, plumbing fixtures and personal accessories such as toothbrushes, combs, cosmetic containers and jewelry items.

Chemaco engineers will be glad to advise you on the correct materials and formulae to meet your specifications. Chemaco molding compounds include thermoplastics with a wide variety of properties and capabilities. Ask about Chemaco Ethyl Cellulose, Polystyrene and Vinyl Compounds.

Chemaco Corporation

A subsidiary of Manufacturers Chemical Corporation

Berkeley Heights, N. J.

Branch Office—Cleveland, O. Representatives—Los Angeles • San Francisco

WE BUY, SELL, PROCESS

PLASTICS SCRAP

ACETATE · BUTYRATE · VINYLS · POLYSTYRENE · ACRYLICS

H. MUEHLSTEIN & Co. INC.

122 EAST 42nd STREET, NEW YORK 17, N. Y.

LOS ANGELES · MEMPHIS · CHICAGO · AKRON 250 Jewett St. · BOSTON 31 St. James Ave.

Get Accustomed to

CUSTOM MADE GUANINE

and

Put Pearl in Your Plastic

Guanine dispersed in plastics produces a variety of novel and arresting effects—BUT every plastic presents different requirements in solvents, and temperature and pressure ranges to be withstood. So, if you want to put pearl in your plastic, write us your requirements and let us custom build our guanine for you.

WRITE FOR DESCRIPTIVE BOOKLET
"MERMAID TO MANMADE"
today

Fine Chemicals Division

IVANO INCORPORATED

166-184 Commercial Street,
Malden 48 — Mass.

AUTO UPHOLSTERY THAT STAYS EVERLASTINGLY NEW

Imagine upholstery that retains its bright colors indefinitely. ...seating on which dirt, grease and even ink can be wiped clean with a damp cloth to keep it constantly fresh and new. Fabrics woven of SARAN BY NATIONAL are tough, resist abrasion and offer no end of long-lasting service.

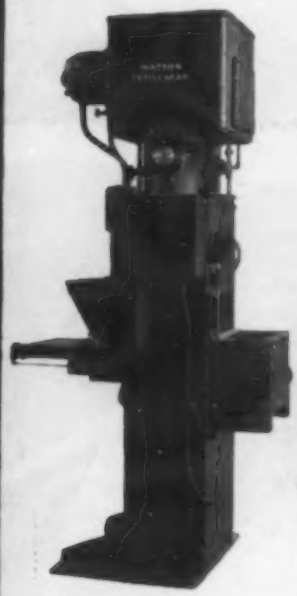
NATIONAL extrudes SARAN monofilament for manufacturers of numerous products. Write for samples of SARAN and we'll be glad to discuss its possibilities in relation to your future plans.

NATIONAL PLASTIC PRODUCTS Company

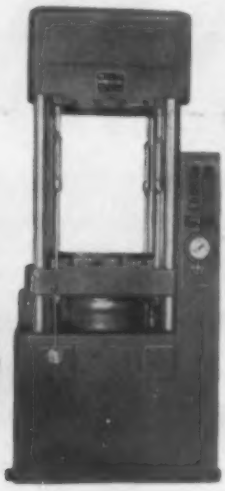
ODENTON, MARYLAND

AN ANSWER TO YOUR PLASTIC PRESS PROBLEMS

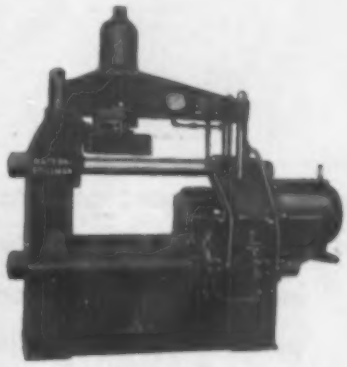
YOU CAN GET the right machine for any molding job from Watson-Stillman . . . builders of the most complete line of hydraulic equipment available for compression and injection molding on large scale production, diversified short runs or in the laboratory. All W-S equipment embodies operating and production features consistent with latest trends in plastic materials and molding techniques. Watson-Stillman offers you unbiased advice on selecting equipment or other molding problems, based on intimate association with the Plastics Industry from its very beginning. Write the Watson-Stillman Company, Roselle, New Jersey.



Automatic Compression Molding Presses



Semi-Automatic Compression Molding Presses



Angle Molding Press

WATSON-STILLMAN
HYDRAULIC MACHINERY DIVISION

FACTORY AND MAIN OFFICE
ROSELLE, NEW JERSEY

BRANCH OFFICES

WASHINGTON, D. C. — NEW HAVEN, CONN.
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INDIANAPOLIS, IND. . . . W. K. Millholland Machinery Co.
CHICAGO, ILL. . . . . E. L. Essley Machinery Co.
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A PERMANENT SURFACE DECORATING PROCESS FOR PLASTICS

Applies Your Name, Your Trade Mark, Your Decoration to Every Type of Plastics Molding. Widely used on containers and closures, perfect for novelties, jewelry, identification, tags, dials, name plates, etc. This process applies all colors integrally to *all* plastics. Special formulations for thermoplastic materials make it impossible to rub, wash or scratch off our imprinting.

Write or call for samples, prices, information.

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14 West 17th Street New York CH 3-6803
Surface Decorators for the Plastics Industry

NOW IS THE TIME

to start post war planning and working on plastic molded parts Our engineers will be glad to call and discuss any problem having to do with compression or transfer molded parts.

RADIO CABINETS all sizes and other large housings are our specialty

All our molds are made by men with more than thirty years experience. Our engineers offer a similar background of experience. Combined, they guarantee production of highest quality, good looking moldings on the highest possible production basis.

CONSULTATION with our engineers is yours for the asking.

Plastimold, INC.
TRADE MARK
ATTLEBORO, MASS.

NOSCO designs a product you'll live with tomorrow

Put *your* ideas for plastics in NOSCO'S CREATIVE HANDS

DESIGN in plastics can make or break your idea . . . controls factors from cost to sales appeal.

NOSCO'S creative hands *know design*—are at your service to appraise *your* need for plastics—to engineer low cost, fine appraisal practicability and sales appeal. *Know Nosco for Nosco Knows*

NOSCO Plastics
DIVISION OF
NATIONAL ORGAN SUPPLY CO. • ERIE, PA.

GOT AN ELECTRICAL PROBLEM?

There are a lot of plastics with insulating properties. Some of these are better for low voltages, others for high. Some are adaptable to high frequency use.

We have made it our business for the last 50 years to know all about the electrical properties of all current plastics. When we started out, there were only shellac and celluloid. Today there are many materials and we mold them all for all electrical purposes.

We specialize in servicing Power Companies, Telephone and Telegraph Companies, Radio Stations and other large users. Insulation is known for a number of electrical specialties such as Safety Strain insulators, terminal blocks and X-ray tube shields. Also lead-in and transformer insulators, as well as insulating supports of many different sizes and shapes.

INSULATION MANUFACTURING CO.

CUSTOM MOLDERS OF PLASTICS FOR INDUSTRY

11 New York Avenue **Brooklyn 16, N. Y.**

Specialists in

COMPRESSION MOLDING

WHETHER you are planning on a big job or a small one, for immediate use or postwar production, call on us. You will find us a dependable source for parts made by compression molding. If you have a molding job under consideration consult us before you set up your production program. Our staff may be able to help smooth the way.

PLASTICS DIVISION

ALLMETAL SCREW PRODUCTS CO.

80 GRAND STREET, NEW YORK 13, N. Y.

Oakite Answers to Plastic Production Problems!

Removing Mold Lubricant From Plastic Parts

LUBRICANTS for molds have varying characteristics designed to prevent adhesion of plastic parts to mold surfaces. Because of the high temperature of the molding process, these lubricants often become sticky and gummy . . . adhere to plastic surfaces. Thorough removal, therefore, is essential for easier handling and subsequent fabrication.

Various specialized Oakite materials are available which will quickly, easily, rid plastic surfaces of accumulations . . . do the job with complete safety. Economical to use, too!

If you are faced with this or any other cleaning or related problem in the manufacture or fabrication of plastic parts, write us today. Oakite Technical Advisory Service is FREE for the asking!

OAKITE PRODUCTS, INC., 46D Thames St., NEW YORK 6, N. Y.

Technical Service Representatives in All Principal Cities of the United States and Canada

OAKITE Buy Bonds for Victory **CLEANING**

THE LEADING GRANULATING MACHINE
of the Plastics Industry

Photograph shows installation of a Ball & Jewell grinding machine in the plant of one of the largest manufacturers of plastics materials. Company policy prevents mention of their name. Ball & Jewell grinders are found in practically all plastics materials manufacturing plants.

The machine shown is one of our larger models, #2, specially made of stainless steel to prevent contamination. This giant grinder handles huge pieces of virgin material and grinds them into granulated form at a rate of up to 2500 lbs. per hour. The machine has 11 solid tool-steel knives, super heavy castings, sealed outboard SKF roller bearings, 3 interchangeable screens for different sized powders—more available. Belt or direct motor drive.

Send for prices, FREE catalog of 13 models.

This is #4 of a series of advertisements showing typical Ball & Jewell scrap grinder installations in the plastics industry.

BALL *and* JEWELL **20 Franklin Street Brooklyn, N. Y.**

or get in touch with nearest representative

CHICAGO: Neff, Kohlbusch & Bissell. DETROIT: J. C. Austerberry's Sons. LOS ANGELES: Moore Machinery Co. LOS ANGELES & SAN FRANCISCO: Machinery Sales Co. NEW ENGLAND: Standard Tool Co., Leominster, Mass. ATLANTA, GA.: George L. Berry. ST. LOUIS: Larrimore Sales Co. SEATTLE 4, WASHINGTON: Olympic Supply Co. KANSAS CITY, KANS.: Fluid Air Engineering Co.: MINNEAPOLIS, MINN.: Winston Hennings Co. HONOLULU, T. H.: The Hawaiian Sales Service, P. O. Box 3498. LONDON, ENGLAND: Blackfriar's Engineering Co., Ltd. AUSTRALIA, and NEW ZEALAND: Scott & Holladay, Pty. Ltd., SYDNEY CANADIAN AGENT: Williams & Wilson, Ltd., Toronto & Montreal, Canada

Time for a Change

If you are tired of having your product shunted from one department to another because of too much red tape, then it is time for a change.

For 25 years we have been proud of the personalized service we have extended to our customers. Their gratification has been evidenced by consistent satisfaction with our performance of their compression molding.

KENILWORTH

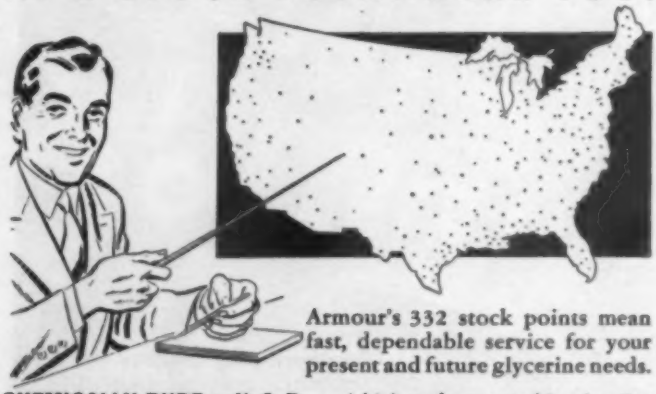
PLASTICS MOLDING COMPANY

Division of Eureka Button Co. (Est. 1885)

KENILWORTH, NEW JERSEY

GLYCERINE

QUICKLY AVAILABLE AT A STOCK POINT NEAR YOU!



Armour's 332 stock points mean fast, dependable service for your present and future glycerine needs.

CHEMICALLY PURE or U. S. P. . . . A high grade, water-white glycerine meeting the requirements of the United States Pharmacopoeia. Suitable for use in foods, pharmaceuticals, cosmetics or for any purpose where the highest quality is demanded. It has a specific gravity of 1.249— 25°C./25°C.

HIGH GRAVITY . . . A pale yellow glycerine for industrial purposes with a specific gravity of 1.262— 15.5°C./15.5°C.

DYNAMITE . . . A yellow glycerine made especially for the explosives trade. It has a specific gravity of 1.262— 15.5°C./15.5°C.

YELLOW DISTILLED . . . A yellow glycerine for industrial purposes with a specific gravity of 1.259— 15.5°C./15.5°C.

ARMOUR AND COMPANY

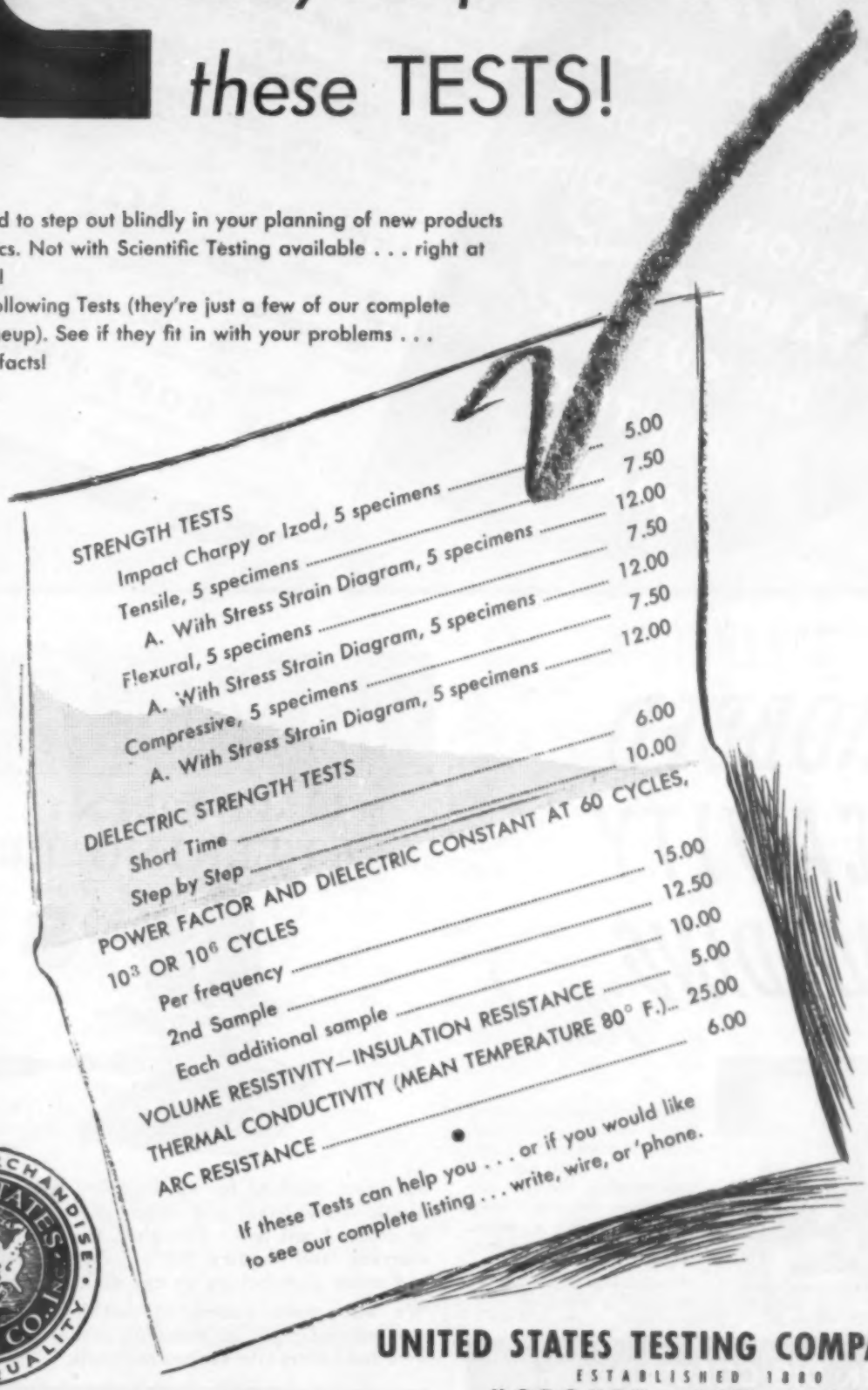
1355 WEST 31ST STREET · CHICAGO 9, ILLINOIS

BEFORE YOU PLAN NEW USES FOR YOUR *PLASTICS*

Get out your pencil and check these TESTS!

There's no need to step out blindly in your planning of new products made of Plastics. Not with Scientific Testing available . . . right at your fingertips!

Check the following Tests (they're just a few of our complete Plastics Test lineup). See if they fit in with your problems . . . your need for facts!



STRENGTH TESTS	
Impact Charpy or Izod, 5 specimens	5.00
Tensile, 5 specimens	7.50
A. With Stress Strain Diagram, 5 specimens	12.00
Flexural, 5 specimens	7.50
A. With Stress Strain Diagram, 5 specimens	12.00
Compressive, 5 specimens	7.50
A. With Stress Strain Diagram, 5 specimens	12.00
DIELECTRIC STRENGTH TESTS	
Short Time	6.00
Step by Step	10.00
POWER FACTOR AND DIELECTRIC CONSTANT AT 60 CYCLES, 10^3 OR 10^6 CYCLES	
Per frequency	15.00
2nd Sample	12.50
Each additional sample	10.00
VOLUME RESISTIVITY—INSULATION RESISTANCE	5.00
THERMAL CONDUCTIVITY (MEAN TEMPERATURE 80° F.)	25.00
ARC RESISTANCE	6.00

If these Tests can help you . . . or if you would like to see our complete listing . . . write, wire, or 'phone.

CERTIFIED MERCHANDISE · UNITED STATES TESTING CO. INC. · SEAL OF QUALITY

UNITED STATES TESTING COMPANY, INC.

ESTABLISHED 1880

HOBOKEN, NEW JERSEY

PHILADELPHIA, PA. · BOSTON, MASS. · WOONSOCKET, R. I. · CHICAGO, ILL. · NEW YORK, N. Y.

Plastics

LAMINATING
INJECTION MOLDING
EXTRUSION MOLDING
FABRICATING
DIE CUTTING
PRINTING
FORMING

LAMINATING with layers of transparent plastics to hermetically seal printed surfaces against moisture, oil and water.

INJECTION MOLDING: Small to medium sized objects molded to any desired shape to meet your specifications.

EXTRUSION MOLDING: Continuous lengths, in any form, cut to any length.

FABRICATING: Wide variety of sheets, flexible or rigid, dull or glossy finish. Wide color range.

DIE CUTTING to any shape desired, done right on our premises.

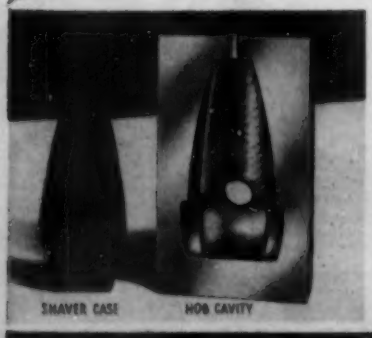
PRINTING: We specialize in printing where extremely close register is imperative.

FORMING OF Sheet Plastics to any desired shape.

Write for Free Booklet,
"Hopp Plastics Today and Tomorrow"

THE HOPP PRESS
INCORPORATED
460 W. 34th St., New York 1, N. Y.

Let's Discuss HOBBED CAVITY MOLDING Now!



Frequently manufacturers thank us for having suggested hobbed cavity molding . . . it's quick, economical, accurate. We have the equipment, specialized help and experience to solve problems along these lines. Write for our comprehensive booklet "The Procedure of Die Hobbing."

NEWARK DIE COMPANY, Inc.
20-24 SCOTT ST. NEWARK, N. J.
Telephone — MARKET 2-3772, 2-3773

NUMBERALL

NUMBERING and LETTERING PRESS

Write for Bulletin MP 240

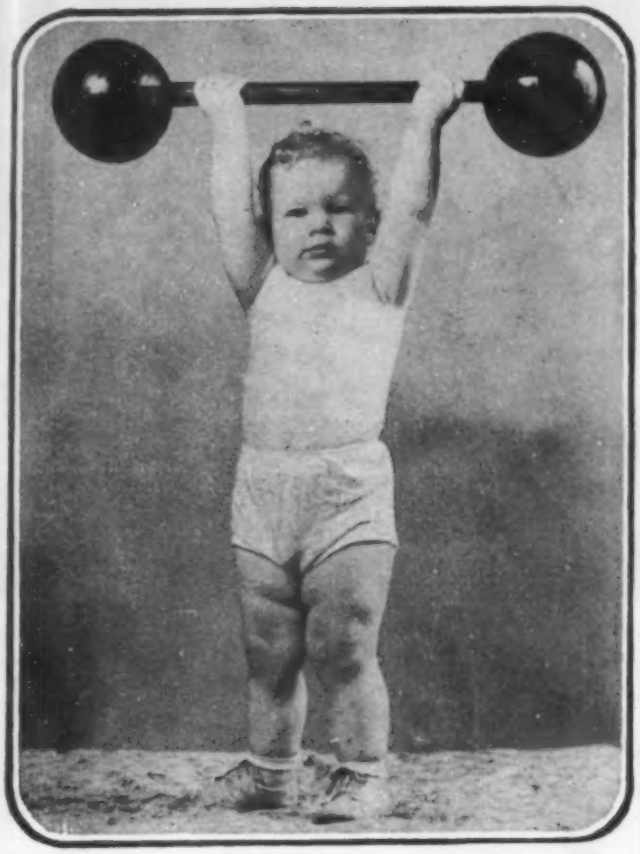
An ideal machine for hot stamping letters and figures on plastic nameplates, and other small parts, with the use of colored roll leaf. Furnished with an electric heating element, and rheostat for regulating heat. All figures and entire alphabet are on one dial.

We also make numbering machines . . . automatic and non-automatic . . . for stamping, either hot or cold, numbers and letters into various materials.

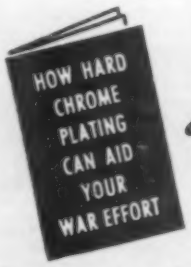
NUMBERALL STAMP & TOOL CO.
HUGUENOT PARK STATEN ISLAND 12, N. Y.

CHROMIUM

Tough WAR BABY WITH A FUTURE



Hard chrome plating is one "war baby" which has already proved its worth for a hundred and one peacetime applications. The war has served simply to accelerate the pace of its acceptance. If you're responsible for production or maintenance, you want the facts on hard chrome plate for 1) increasing the efficiency of tools, dies and molds, 2) production jobs, and 3) salvage. Include hard chrome plating in your present and post-war planning.



KEEP UP-TO-DATE WITH HARTFORD CHROME

***Free* "Show-How" Literature**

Concise, important information for Tool Engineers, Plant Managers, Foremen, Purchasing Agents, etc. Tell us how many copies you want.

HARTFORD CHROME CORP.

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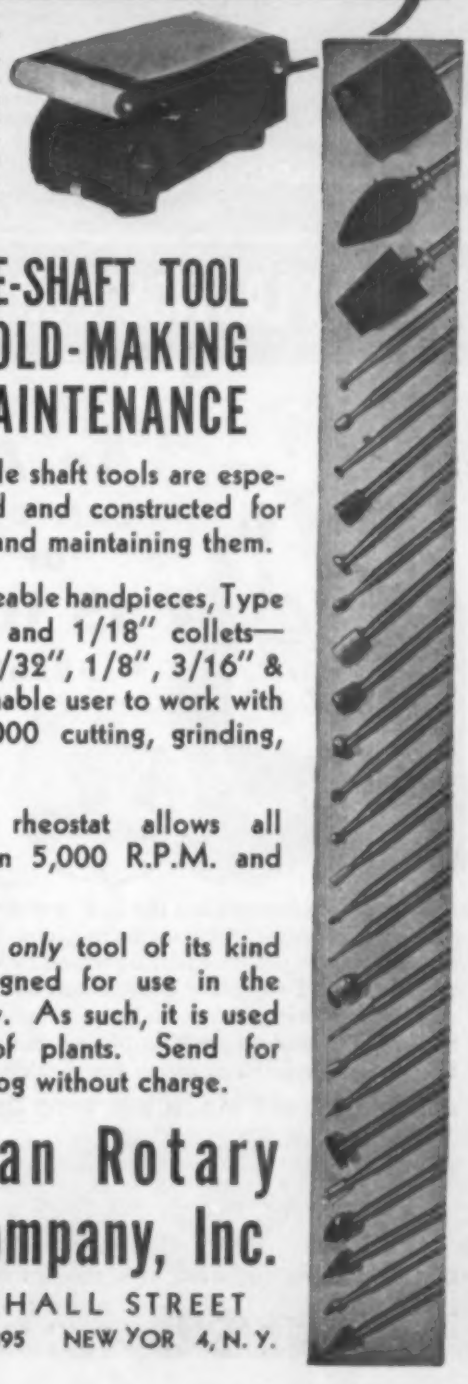
WE SERVE NEW ENGLAND, NEW YORK AND NEW JERSEY

Licensed by United Chromium Inc.

Unit F with K handpiece. 1/8 H.P., 20,000 R. P. M. Other Models from 1/20 H.P. to 1/3 H.P. and up to 22,000 R. P. M. 8 Different speeds, rheostat controlled.



FLEXIBLE-SHAFT TOOL FOR MOLD-MAKING AND MAINTENANCE

ARTCO flexible shaft tools are especially designed and constructed for making molds and maintaining them.

Two interchangeable handpieces, Type K with 3/32" and 1/18" collets—Type H with 3/32", 1/8", 3/16" & 1/4" collets enable user to work with more than 1,000 cutting, grinding, polishing tips.

Foot-operated rheostat allows all speeds between 5,000 R.P.M. and 20,000 R.P.M.

ARTCO is the *only* tool of its kind especially designed for use in the plastics industry. As such, it is used in hundreds of plants. Send for Complete Catalog without charge.

American Rotary Tools Company, Inc.

44 WHITEHALL STREET

BOwling Green 9-4895 NEW YOR 4, N. Y.

HAPPY COMBINATION

- Men - Equipment

NO MATTER HOW FINE and modern our equipment may be, the quality of the finished product is still dependent upon the ability of our engineers and the men who run the machines.

IT IS THIS *HAPPY COMBINATION* of just the right men and just the right equipment that makes IDEAL PLASTICS so readily recognizable as products of the highest quality.

IDEAL PLASTICS CORPORATION

A DIVISION OF IDEAL NOVELTY & TOY CO., INC.
23-10 43rd AVE., LONG ISLAND CITY, N. Y.

An ARM CAN DELIVER UP TO 15 TONS PRESSURE

Exclusive Famco gib adjustment keeps ram aligned, compensates for wear, eliminates "shimmy."

Famco Arbor Presses are the low cost solution for thousands of assembly and dismantling jobs. They require no electric power, yet are easily operated by women. They're available in 32 ruggedly constructed models, (for bench or floor mounting), in plain lever, simple ratchet or combination compound and simple ratchet types. See your Famco dealer or write today for catalog.

FOOT-POWERED MACHINES THAT USE NO POWER

Famco Foot Presses for light forming and stamping are available in 10 models (for bench or floor mounting.) Low cost, low upkeep.

Famco Foot Powered Squaring Shears will cut up to 18 gauge mild steel with ease. Available in five ruggedly constructed sizes.

FAMCO MACHINE CO., 4308 18th Street, RACINE, WISCONSIN

famco ARBOR PRESSES
FOOT PRESSES
SQUARING SHEARS

Remove Moisture from PLASTICS *Quickly and Cheaply* with NALCO *Infra-Red* LAMPS

Do you know . . . all of the advantages of Infra-Red Ray Drying with Nalco Dritherm Carbon Filament Lamps?

Use Nalco Ditherm Lamps for efficient results . . . available in Inside-Silvered (self-reflecting) or clear glass types.

Learn all of the advantages of the Infra-Red process for plastic dehydration.

Write for your free copy of "Drying Problems Made Easy" today.

Exterior of Infra-Red Conveyor Belt Tunnel for removing moisture from plastic material prior to molding.

Sides dropped to show arrangement of Infra-Red light bank and materials passing under light conveyor belt.

North American Electric Lamp Co.
1012 Tyler Street St. Louis 6, Missouri

NALCO

INJECTION MOLDING

MINCOR

YOUR PLASTICS DEPARTMENT

Small Headaches of Today

FACILITIES:

DESIGN AND MOLD SHOP
PRINTING DEPARTMENT
FINISHING DEPARTMENT

INJECTION MOLDERS OF:

TENITE I LUCITE
TENITE II POLYSTYRENE
VINYLITE LUMARITH
PLEXIGLAS

MINNESOTA PLASTICS CORP.

366 WACOUTA ST.
ST. PAUL 1, MINNESOTA

AUBURN ENGINEERING...

to help solve your Molded Plastic Problems

Does the design lend itself to plastic molding? Could it be made better? What plastic will be best? These are questions for experts to answer.

Auburn's engineers have been solving such problems for 70 years. From design stage to delivery, engineering "know-how" means uninterrupted production of perfect parts.

•

For small parts molded automatically at low cost, write: Woodruff Company Division, Auburn Button Works, Auburn, New York.

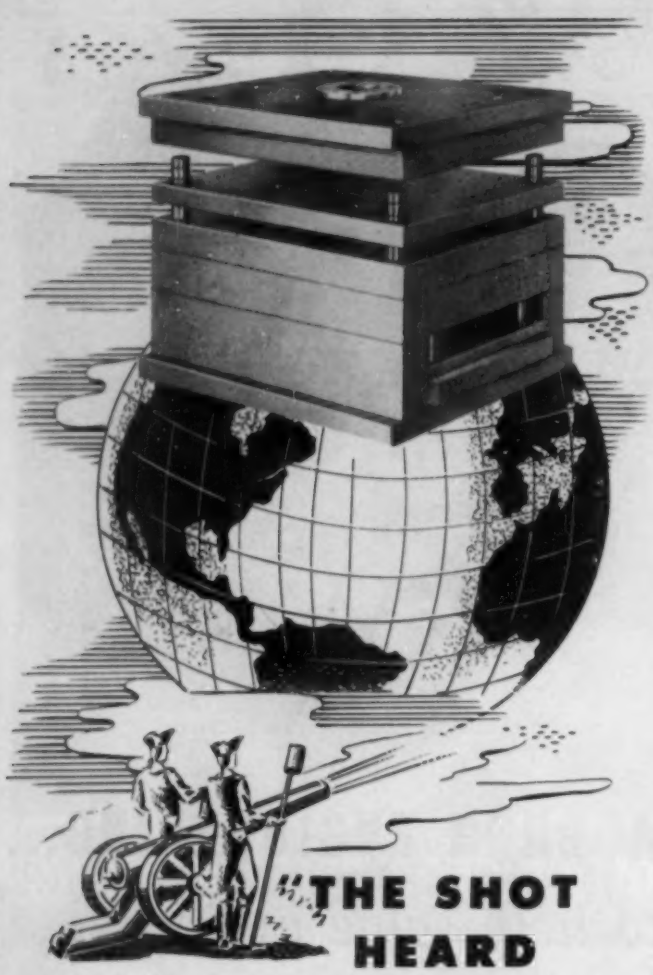
MOLD AB MARK

AUBURN ENGINEERED PLASTICS

All Types of Plastics — Complete Mold Shop
Extruded Tubes and Sheets

AUBURN BUTTON WORKS

Incorporated



"THE SHOT HEARD 'ROUND the WORLD"

This familiar phrase from American history aptly describes how the fame of DME Standard Mold Bases has spread throughout the world. From "away down under" in Australia . . . from many countries in South America . . . from Mexico . . . from Canada . . . from points all over the globe have come inquiries and orders for DME Standard Mold Bases and DME Standard Mold Base Parts.

Progressive mold makers everywhere are recognizing today the labor-saving, time-saving, money-saving advantages offered by completely assembled DME Mold Bases. These bases come to you with all the preliminary engineering done—ready for you to install cores, cavities, etc. Acquaint yourself with all the facts concerning DME Mold Bases. Write for complete details *today*.

DME NEWS will be mailed you monthly upon your request.

DME
DETROIT MOLD ENGINEERING COMPANY
6686 E. McNICHOLS RD. • DETROIT 12, MICHIGAN

WEAR OUT THE OLD ONES THEN BUY NEW *KANES*...

Wear out your old boilers *first*, then get one or more new KANES and be ready for the post war rush that the increased use of plastic articles is sure to bring.

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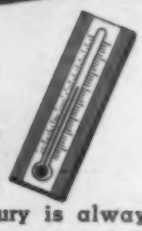

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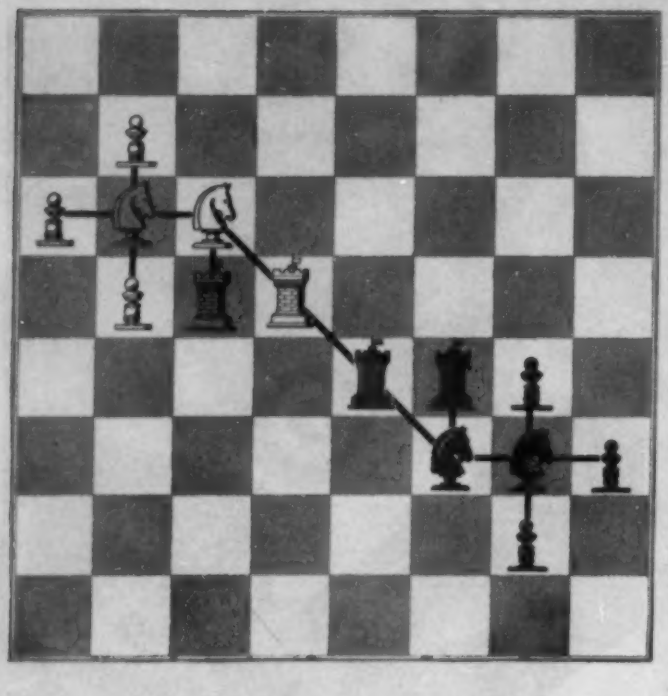

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Perhaps chess was played before Brodie first began his investigations of Acetyl Peroxide in 1863; and certainly prior to a continuation of his studies by Vanino, Clover, Richmond, Gambarjan and Kharash. But its use was more risky than playing chess, for Kharash said of Acetyl Peroxide in the Journal of the American Chemical Society: "An outstanding peroxide of great usefulness but must be used on the spot (of manufacture) because of its sensitivity."

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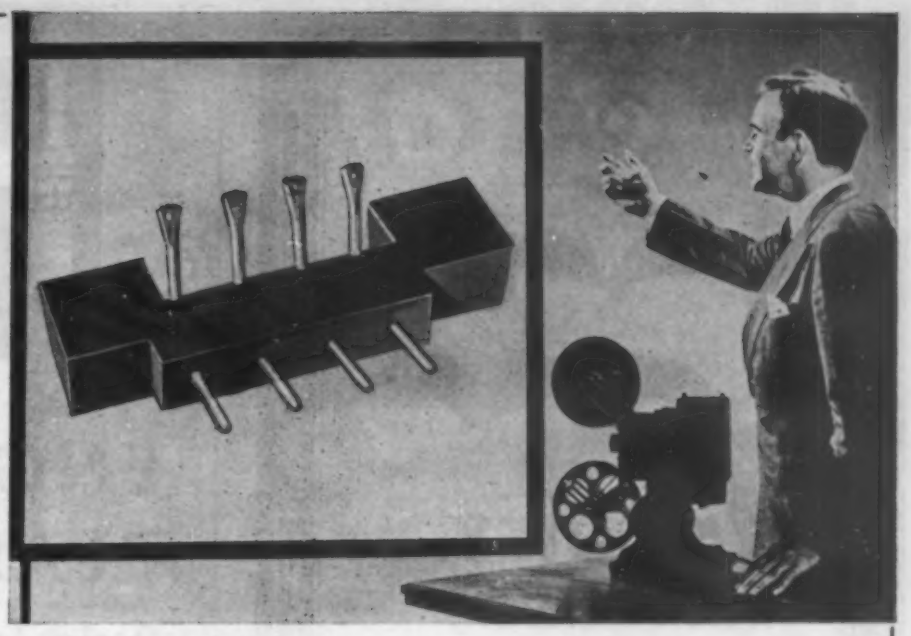

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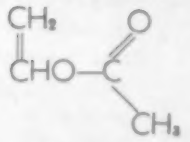

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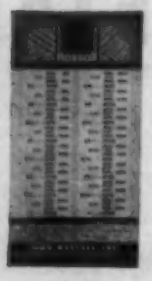

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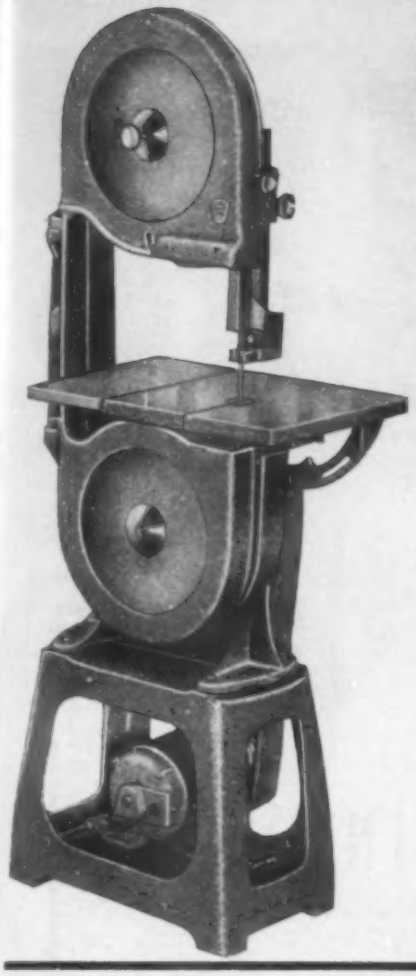

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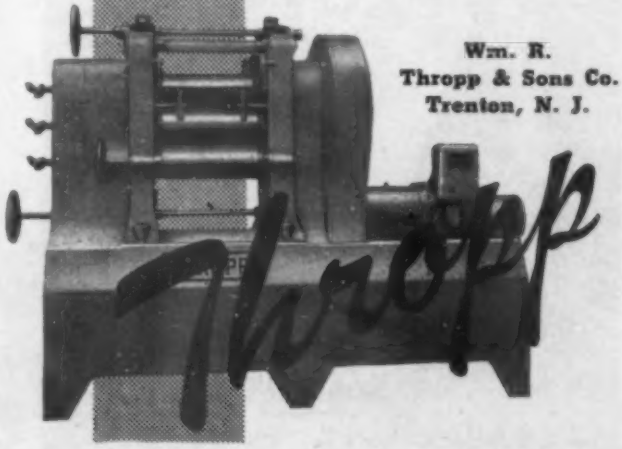

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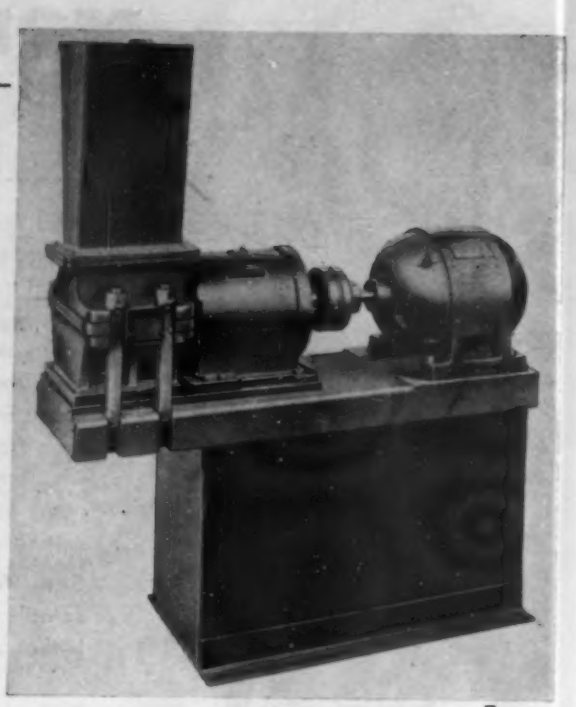

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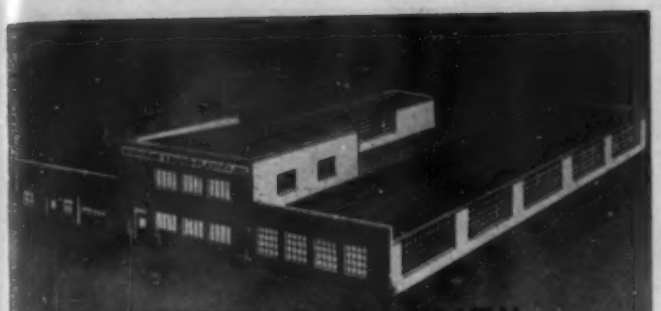

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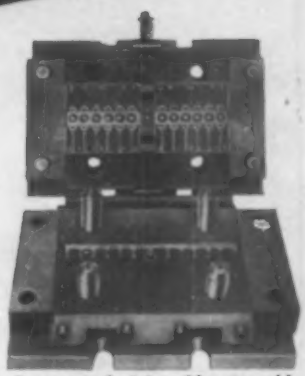

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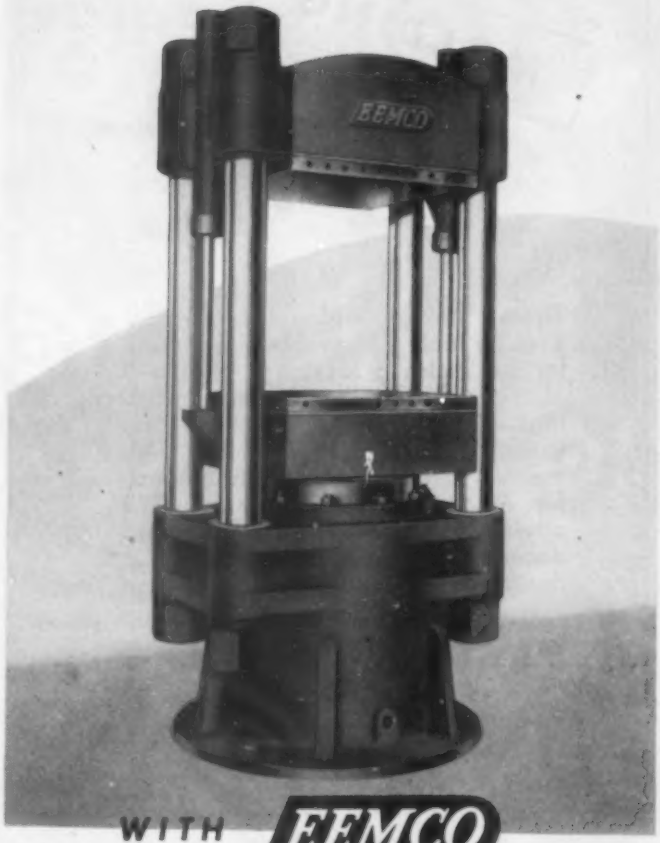

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Buy WAR BONDS AND STAMPS

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Robinson Industries, Inc. - - FRANKLIN, PA.

WALKER GOULARD PLEHN CO. ESTABLISHED 1855

Saturating Papers for PLASTICS

W.G.P. furnishes saturating papers for the impregnation of thermo-plastic and thermo-setting types of resins in fluid form for medium or high degree of absorption. We can also supply saturating papers in 100% rag base in colors. Manufacturers of leather substitutes from natural or synthetic rubber latex for consumption in the luggage and shoe trades should investigate the unusual qualities of saturating papers offered by W.G.P.

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EXPORTS TO ALL PARTS OF THE WORLD

Specialized STEARATES OF ZINC CALCIUM ALUMINUM

● As molding speeds climb steadily higher, it becomes more *essential* to provide better lubrication both for the molding material and for the mold itself. For the complete answer to both these problems, it will pay you to turn to Metasap. For, in addition to giving worry-free lubrication, Metasap Metallic Soaps supply a very desirable plasticizing effect. For further information, write.

METASAP CHEMICAL COMPANY

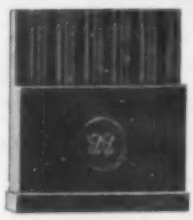
PALMITATES STEARATES of ALUMINUM, CALCIUM, LEAD, ZINC

Harrison, N. J., Boston, Richmond, Calif., Chicago, Cedartown, Ga.

CONTRACT
PLASTICS MOLDING
INJECTION AND COMPRESSION MOLDING IN ALL THERMOPLASTIC AND THERMOSETTING MATERIALS

We have the set-up and experience to give you the best in plastics molding of small and large parts, in small or large quantities, at reasonable prices.

EXAMPLE OF ACCURATE SMALL DIA. MULTIPLE CORE PIN INJECTION MOLDING



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THE S. S. WHITE DENTAL MFG. CO.
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Sifters, Crushers, Cutters, Dry and Liquid Mixers, Mills, Grinders, Pulverizers, Conveyor Systems, Complete Installations.

The handling equipment construction "know-how" of the Mercer Engineering Works, Inc., Clifton, N. J. . . . The more than 40 years processing equipment experience of Robinson Mfg. Co., Muncy, Pa. . . . All are embodied in and represented by

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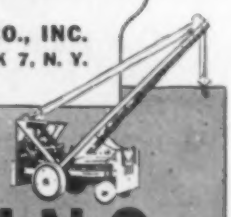

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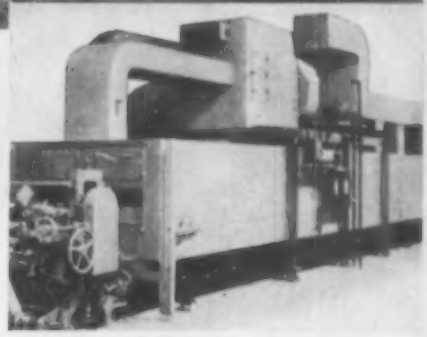
EQUIPMENT

Trailer Trucks (All Types) Wheel Tractor Cranes (3 to 7 ton) Fork Lift Trucks, Lift Platforms, Hoists, Live Skids, Wheels, Casters.

In The Home Of The Famous
TAYLOR
LAMINATED PLASTICS



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IN the products of the TAYLOR FIBRE COMPANY, Norristown, Pa., their outstanding "quality is something that doesn't just happen." A predetermined high standard is set and every step in the production must contribute to the achievement of that standard. It is significant that for the all-important processes of laminating, treating, drying and curing, ROSS* TREATING SYSTEMS were selected to maintain the uniform quality that is characteristic of all TAYLOR LAMINATED PLASTICS.

Users of ROSS PLASTIC TREATING SYSTEMS include practically all the famous manufacturers of products being developed from paper or fabric combined with plastics in solution. Detailed information and laboratory facilities are available to you.

*Mechanical treating apparatus furnished by John Waldron Corporation. Air processing and drying systems by J. O. Ross Engineering Corporation.

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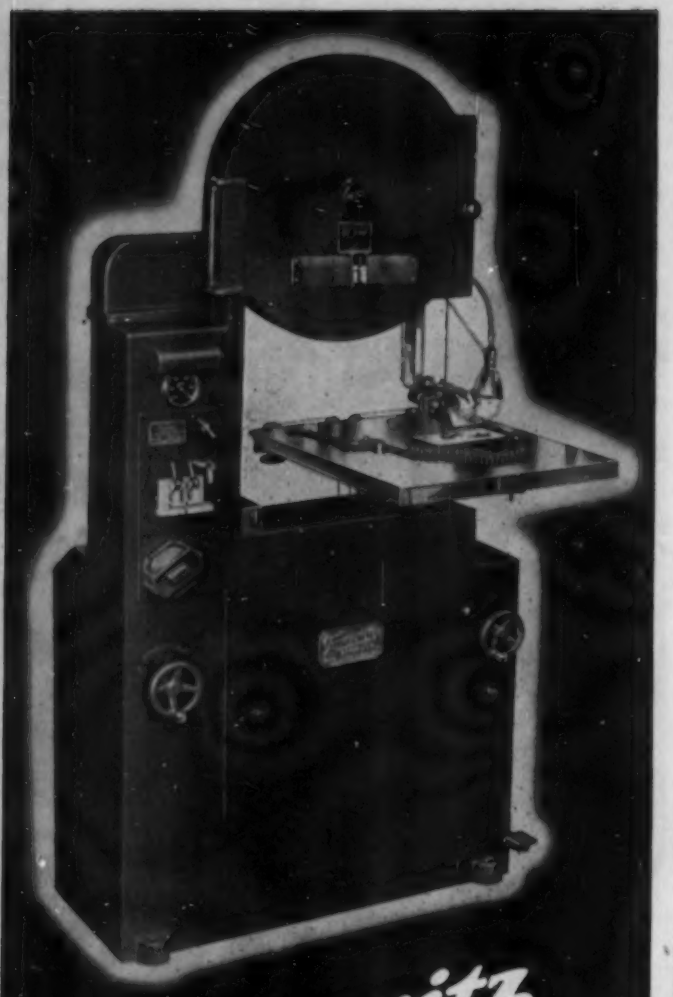
ROSS ENGINEERING OF CANADA, LIMITED — Dominion Square Building, MONTREAL, P. Q.
CARRIER—ROSS ENGINEERING COMPANY, LIMITED, LONDON, ENGLAND



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Effect Radical Reductions in the Cost of Die-Making

With this machine you can do in minutes jobs which require hours by the shaper, miller or lathe methods. It provides for quick and smooth inside or outside sawing, using blades 3/32" to ½" wide — inside and outside chain filing with three different file widths — inside and outside endless belt polishing. It's one of the greatest time and money saving machine tools ever produced. Standard Model 24M has full 24" wheels, instant change of speeds to suit every type of job and is constructed to give you many years of trouble-free service. Get the complete facts. Simply write for "No. 24M DI-SAW" Bulletin. Other models of larger capacity for special application are also available. Information on request.

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SPACE and STRIP HEATERS

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BAND HEATERS—COIL and MICA ELEMENTS

All types of thermostatically controlled ovens and hot plates as well as special heating elements custom made to your own specifications.

GLENN ELECTRIC HEATER CO.
239-241 Canal Street
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PLASTIC MOLDS

25 years experience in designing and building molds for leading molders.

Our plant is modern in equipment for producing the best in molds. Compression, Injection, Transfer.

SOCIETY OF THE PLASTICS INDUSTRY · SPI

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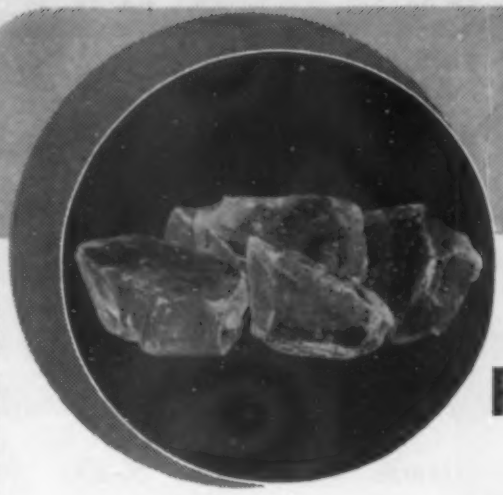

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Produced Under Precision Controls for Exacting Plastics Production . . .

PICCOLASTIC Modified Styrene Resins in a wide range of molecular weights, melting points and solvencies. In combination with each other or with other plastic bodies make possible the creation of results hitherto unattainable . .

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A complete line of Precision plasticizers to meet the requirements of all types of plastics compounding . . . Our laboratory will assist in determining the plasticizer best suited to your compounding problems. Write for complete data

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Joining Rigid Plastics

TO GLASS, METAL, WOOD, FABRIC, LEATHER OR OTHER PLASTICS?

Our research and Technical Staff is experienced in developing specialized adhesives for special applications, including the plastic field. They may help you to bond these joints with Miracle Adhesives *without the need for screws, clips or mechanical fasteners—and without heat.*

We can serve you best when you send full details to Research Department, Miracle Adhesives Corporation, 852 Clinton Avenue, Newark 8, New Jersey.

MIRACLE ADHESIVES

HOW MISKELLA INFRA-RED OVENS AND APPLIANCES SERVE THE PLASTIC INDUSTRY

Branch of the Industry	Name of Appliance	Use
Molders (Thermo-setting) Compression	PELLET-VEYOR (Variable heat)	To preheat pellets and preforms at the press as needed
Molders (Thermo-plastic) Injection	VIBRA-VEYOR (Variable heat)	To preheat plastic powder automatically. To dry plastic powder automatically
Injection	HOPPER-HEATER (Variable heat)	To warm up heavy metal of hopper of molding machine
Molders (Thermo-plastic) Extrusion	STRIP-HEATER (Variable heat)	To preheat strip rolls of vinylite, etc., automatically as fed to worm
Material Manufacturers	Special production Equipment including vibrators, conveyors, stainless steel belts and electronic devices	To process various kinds of plastic material in bulk
Fabricators (Miscellaneous)	BENCH-KIT In various sizes (Variable heat)	To soften sheets, rods, tubes and any shape for bending, forming punching, etc. This includes Cellulose, Acetate, Methyl Methacrylate

(The time on most of the operations mentioned above averages five minutes)
We sell lamps and build completely engineered infra-red equipment and appliance installations.

Drying, Baking, Processing and Preheating Specialties

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Main Office and Laboratory
1637 East Fortieth Street, Cleveland, Ohio

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for

Laminators and Molders

Our Southern mills have made high-tensile cotton fabrics for the Plastics Industry for fifteen years and specialty industrial cotton textiles for over thirty-five years. Our experienced development and production facilities are available to the Plastics trade, limited only by the requirements of our armed forces.

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320 BROADWAY NEW YORK CITY

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Subject to allocation by the War Production Board in accordance with Order M-300 Schedule 61.

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Slip Ring Assemblies

Custom Molded Plastics engineered by Midwest, consistently measure up to exacting specifications and requirements. Address your inquiries to MMM, confident that you are consulting an organization skilled and experienced in precision techniques for the production of plastics.

Midwest Molding

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A complete and thoroughly equipped molding plant with an enviable record of performance for many of the largest users of molded parts, products, premiums and packages

Call upon our engineers and designers for aid or advice in planning your molded parts.

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You can avoid

High Pressure Reducing

Valve Troubles

At the right we show a valve that handles working pressures up to 6000 pounds, without shock. Many of the leading plastics plants are using it and are well pleased with its performance. It is known as

ATLAS Type "E"

High Pressure Reducing Valve

Forged Steel Body. For oil as well as water and air. Truly modern in every respect. Internal metal parts are entirely of stainless steel. A formed packing of special material superior to leather is used which is immune to all fluids commonly used in hydraulic machinery. The pressure on the seat is balanced by a piston with the result that variations in high initial pressure have little effect on the reduced pressure.

Ask for complete information.

For other ATLAS plastics plant products see the partial list in our ad in the January issue of MODERN PLASTICS

ATLAS VALVE COMPANY

REGULATING VALVES FOR EVERY SERVICE

277 South Street, Newark 5, N. J.

Representatives in principal Cities

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—IF YOU USE EQUIPMENT FABRICATED OF ALUMINUM, STEEL OR ALLOY PLATE

This 44-page bulletin presents the extensiveness of our modern facilities and methods for producing special tanks, kettles, pressure vessels, and processing equipment. It shows many of the various types of equipment we have produced during our many years experience in metal fabrication. It is designed to show you why we are fitted to produce economically and satisfactorily such equipment for you. Write for Bulletin G-45 today.

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ENGINEERS • FABRICATORS • RECOGNIZED EXPERIENCE & FACILITIES

The STACEY BROS. Gas Construction Co.

One of the Dresser Industries

5535 Vine Street
Cincinnati 16, Ohio

THE SHAPE OF TRIMS TO COME . . . again

Perfection of design in silverware trim, prime examples of our fabricating techniques, will again become a prerequisite of selling appeal. We will not slight our current war production as long as it is needed, but we are most anxious to have you thoroughly familiar with our ability as plastic engineers to fabricate unusual shapes and sizes. May we talk with you sometime soon?

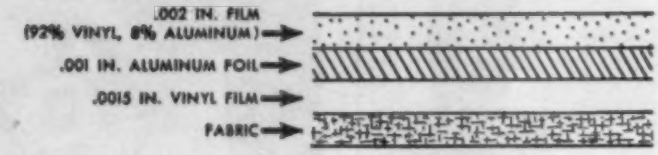
We specialize in the custom fabrication of plastic parts of every description.

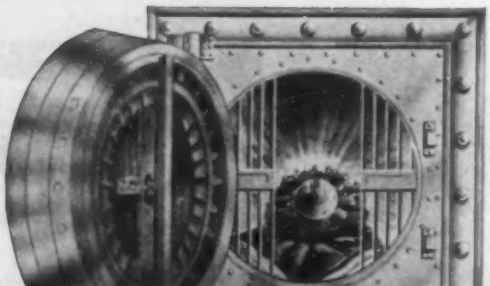
Catalin
Acrylics
Polystyrene
Cellulose Acetate
Laminates

PLASTIC
Turning Co. Inc.
LEOMINSTER, MASS.

The Composition of

PLASTIN* A-6006





Like a precious gem in a bank vault, products packaged in Plastin A-6006 receive the ultimate in protection. As the massive steel and concrete of a vault protects against thieves and vandals, so the aluminum and plastic of Plastin A-6006 protect against moisture-vapor and other corrosive agents. Plastin A-6006 surpasses all requirements for Type I barriers for moisture-vapor and provides lasting protection for extremes of temperatures, time and service conditions, from −40°F in the Arctic to 205°F in the tropic sun. In all sizes from 2" x 3" envelopes to 10′ x 20′ floating barriers, it will insure corrosion-free equipment. Plastin A-6006 is the greatest victory ever recorded in the battle against moisture-vapor. A sample and list of characteristics are included in a folder mailed promptly on request.

PLASTIC FILM CORPORATION

TELEPHONE: LEXINGTON 2-5458 • 475 FIFTH AVENUE, NEW YORK 17, N. Y.

**T. M. Reg. U. S. Pat. Off. Pat. Pending*

All classified advertising payable in advance of publication. Minimum, $5.00 (up to 60 words); in border, $10.00 per inch.

Classified Advertisements

For further information address Classified Advertising Dept. MODERN PLASTICS 122 East 42nd St., New York 17, N. Y.

WANTED: PLASTIC SCRAP OR REJECTS in any form. Cellulose Acetate, Butyrate, Polystyrene, Acrylic, Vinyl Resin, etc. Also wanted surplus lots of phenolic and urea molding materials. Custom grinding and magnetizing. Reply Box 318, Modern Plastics.

FOR SALE—1 Worthington Hyd. Pump 1 x 6, 5 GPM 6000 pressure M.D. 1 Set 18" x 36" compounding rolls. 1—14"x 24" Press, 9" ram; 4—24" x 55" steel cord Heating Platens; 4—W. & P. Mixers; 4—Semi-Automatic 100-ton Hydr. Presses, platen area 20" x 36"; Allen 6" Tuber; Dry Powder Mixers; Pulverizers, Grinders, etc. Send for complete list. Reply Box 447, Modern Plastics.

FOR SALE: 1—300 ton Hydraulic Press with downward moving ram and pushbacks. Box 512, Modern Plastics.

PERMANENT CHEMIST WANTED for Research Laboratory investigations to improve and develop synthetic resin adhesives—essential war work at present. Salary in line with experience.

Plant within 200 miles of New York City. Attractive town and working conditions.

Applicant should have Ph.D. and organic chemical research experience, preferably in urea-, phenol- or resorcinol-resin adhesives.

Write, giving age, education, draft status, experience, salary expected and photo if available. Address R. J. Spahr, Casein Company of America, Bainbridge, N. Y.

IN THE MARKET FOR: Stainless Steel or Nickel Kettles, Vacuum Pan, Preform Machine and Mixer, Hydraulic Presses. Reply Box 825, Modern Plastics.

CANADA, A Large Post War Market—Wide-awake, reliable Canadian sales organization, having connections with wholesale hardware, chain and department store trade, can accept representation for additional factory requiring Canadian factory agents operating on commission basis, providing line does not conflict with present representations. H. HACKING CO. LTD., 144 Water Street, Vancouver, Canada (Est. 1916). Canadian Branches from Coast to Coast.

WANTED: THERMOPLASTIC SCRAP or rejects in any form, including Acetate, Butyrate, Styrene, Acrylic and Vinyl Resin materials. Submit samples and details of quantities, grades and color for our quotations. Reply Box 508, Modern Plastics.

WANTED: Small or medium sized plastic molding plant with either hydraulic extrusion or injection equipment with or without tool shop. Advise full details. Reply Box 788, Modern Plastics.

WANTED: Chemist or Chemical Engineer, experienced in production control and testing of Plastics. To assume charge of Laboratory testing, development work and some field service. Prefer individual with training in thermosetting laminates. Give experience, education, draft status, send photograph if possible. Location—Mid-West. All replies held strictly confidential. Reply Box 1162, Modern Plastics

PLEXIGLAS and LUCITE SCRAP WANTED. Interested in small and large quantities of clean, irregular-shaped flat pieces, strips, rods and other cut-offs. All thicknesses; masked and unmasked. Kindly describe fully, stating quantity available. Box 1210, Modern Plastics.

PRODUCT DESIGN ENGINEER—Graduate architect or industrial design engineer, under 35 years of age, to initiate and develop new consumer product designs in glass. Should have manufacturing experience and ability to coordinate his work with Sales, Production and Research departments.

Here is a real opportunity to join America's leading glass manufacturing company. This is a new position, with excellent prospects for the man willing and able to do creative work. If not now engaged in essential war work, write Personnel Department, giving complete description of education, professional experience, draft status. Enclose recent photograph. Salary commensurate with abilities. All replies confidential.

CORNING GLASS WORKS
Corning, New York

WANTED: Cellulose Nitrate sheets or strips of .060 to .070 thickness, suitable for stamping blanks from ¾ inch to 3 inch diameter. Prefer transparent but can use some laminated in colors. Send samples with quotations to Florida Supply House, 415—12th St., Bradenton, Florida.

POSITION WANTED: Plastic Engineer—Age 46. Excellent personality and appearance Capable of Mold designing, research and management in Plastic plant. Reply Box 1219, Modern Plastics.

WANTED—Taber Edger for acetate sheets. State model and price in first letter. Cooks'—Inc., Camden, N. J.

Available now in commercial quantities, the new low price filler, to increase tensile-bonding:
"SHREDDEDAL-LEATHER FIBERS"
(Unusual Long-Length)
For Plastics, Synthetic Soles, Etc.
For complete data and sample, write to
Consolidated Fibre Corporation
(Manufacturers)
633 Middlesex Street, Lowell, Mass.

FACTORY REPRESENTATIVE: I have had twenty years experience selling to drug stores, drug jobbers, drug chains, and department stores in the greater Philadelphia district. Want direct factory representation for items adaptable to this fertile plastic field. Desire connections for numbers now ready for delivery. Also willing to do ground work on merchandise to be released when the war emergency allows. Can do an outstanding job. Highest references. Reply Box 1220, Modern Plastics.

WANTED TO BUY: Plastic scrap, plexiglas sheet trimmings, bar or tube ends, rejects, surpluses, any sizes that could possibly be used by rehabilitation workshops or home craftsmen as material to turn in lathes, cut with saws or otherwise fabricate into any useful or ornamental object. Please send samples and advise quantity available. Industrial Engineering & Manufacturing Co., Ltd., Los Angeles 6, California.

CHEMICAL ENGINEER—PLASTICS: Thoroughly experienced in thermosetting resins and pulp moulding. Capable of research, management or sales. Desires responsible position in supervisory management or sales. M. I. T. Chemical Engineering. Reply to Box 1221, Modern Plastics.

INJECTION MOLDING MACHINE 4-8 OUNCE. IMMEDIATE OR EARLY DELIVERY. Reply Box 1222, Modern Plastics.

FRANCE

Wanted for France Agency of Manufacturers of Machinery for the Making of Plywood and other Plastics. Excellent References. Address Box 1223, Modern Plastics.

DETROIT DESIGNING SERVICE
Specializing in Designing of Machines, Tools, Stamping Dies, and Plastics Molds.
We also do plant layout and postwar planning.
7104 W. Warren Ave. Detroit, Mich.
TY 71641

MICROSCOPIC EXAMINATION OF PLASTICS reveals many important features, contributes to improved production. GEORGE S. RÉV, Laboratory for Microscopic Preparations, Schermerhorn Hall, Columbia University, New York 27, N. Y. (Tel.: UN 4-3200, Ext. 345). Specializing in high grade THIN SECTIONS OF PLASTICS!

WELL-ORGANIZED and well-rated Mexican export and import firm with best references, members of American Chamber of Commerce of Mexico, seek connections with manufacturers of plastics for import to Mexico on own account or commission basis. Write P. O. Box 2554, Mexico City.

FOR SALE: One Kux Model 60 single punch Preform Machine, serial #6044365, with 5 H.P. Reeves motor driven Variable Speed Drive, serial #5KG-284D11, 220 volt, 60 cycle, 3 phase, overload push button switch, belts, pulley, guards and motor mounting. Purchased April, 1943. AS IS condition. Subject to prior sale. Ceiling Price $2784.00, FOB Decatur, Illinois. Available about May 15, 1945. Manufacturer's rating—maximum diameter tablet 2½"; maximum depth of fill 2"; maximum pressure 30 Ton. This machine now in service and is being released because of procurement of larger machine.

THE GRIGOLEIT COMPANY
400 Short Street, Decatur, Illinois

LINE WANTED: A live-wire sales representative covering all big chain stores and jobbers desires to contact a reputable manufacturer of plastic items, preferably Novelties, Housewares, Toys or Notions. I am thoroughly familiar in the plastic field having marketed many nationally known products. I maintain a New York office, have an extensive following and can assure you of volume distribution. Commission basis, or will finance. Reply Box 1224, Modern Plastics.

WANT WORK for 50 Ton and 100 Ton Plastic Compression Molding Presses. Can start work immediately. Minnesota Aircraft Company, 2526 Nicollet Avenue, Minneapolis 4, Minnesota.

MOLDING AND LAMINATING PRESS
Can make immediate delivery on new 12-ton hydraulic press. 8 x 8 platens, 6 inch stroke. Includes electric hot plates and thermostat, $210.00 f.o.b. Cleveland, Ohio. Reply Box 1234 Modern Plastics

FOR SALE

1—Rodgers 2 plunger Oil Pump 2 GPM 3000#; 1—Logan Oil Pump 5 GPM 750#; 3—Vickers Oil Pumps 17 GPM 500 to 1000#; 1—Metalwood Horizontal 4 plunger 1 GPM 3000#; 1—Rumsey Vertical Triplex 300 cubic inches 3000#; 2—Deane Worthington Triplex Pumps 400 cubic inches 4000#; 1—Gould Vertical Triplex 24 GPM 2500#; 1—Robertson Vertical Triplex Pump 7 GPM 5000#; 1—Robertson Vertical Triplex Pump 4 GPM 6500#; 2—Gould Vertical Triplex Pumps 200 GPM 500#; 1—Elmes Horizontal 4 plunger 6½ gallons 5000#; 1—Watson Stillman Horizontal 4 plunger 11 GPM 5000#; 2—Galland Henning Horizontal 4 plunger Pumps 50 GPM 2000#; 2—42 x 42" 14" ram presses; 2—80 ton Elmes 17 x 17" downward-moving ram presses; 1—Elmes 50 ton 18 x 18" downward-moving ram press; 2—30 ton Watson Stillman 12 x 12" Laboratory Presses. Reply Box 1235, Modern Plastics.

MAN with some experience in rubber compounding for position with small but well established synthetic resin manufacturer in Chicago area. Will work on customers technical problems. Position will lead to technical sales and service work for qualified man. Starting salary $3000 to $3300 depending on qualifications. Send full information including education, experience, and recent photograph. Address Box 1226, Modern Plastics.

SWEDEN

Successful firm established 1928 anxious to represent leading manufacturer (not export houses) moulding powders and resins also varnishes for electrical and insulating purposes, etc. Favorably known to all large users in Radio and Electrical Industries. Suggest immediate collaboration for maximum advantage. Reply Box 1228, Modern Plastics.

WANTED: Engineer to supervise inspection and handle technical sales problems for Eastern molding firm. Plant experience in injection molding and familiarity with die design desirable. Reply Box 1186, Modern Plastics.

Attention Manufacturers!

YOU NEED INTENSIVE & SUCCESSFUL REPRESENTATION WHERE BIGGEST BUSINESS CAN AND MUST BE PRODUCED.

My field is NEW YORK & CHICAGO. My customers are JOBBERS, MAIL ORDER HOUSES, CHAINSTORE CONCERNS.

I am a reputable, well established factory-representative, doing considerable business.

I wish to represent in addition **to my present sources for now and post-war**

SIZABLE PLASTICS MOLDING AND FABRICATING CONCERNS

capable to produce better grade novelties, boxes, trays, vanity sets, display cabinets and stands and other articles which I shall suggest.

I do successfully most of the styling for my present sources.

Best references will be furnished.

Reply Box 1227, Modern Plastics

FOR SALE: Hydraulic Presses, 600 ton Watson Stillman 24″ x 24″ double acting ram, 1—36″ x 36″ 200 ton all steel construction 12″ ram, 4—2 post 18″ x 20″ 8″ rams, 32″ x 26″ 400 tons, 14″ ram, 2—12″ x 12″ 7½″ rams, 2—12″ x 12″ 8″ rams, 20″ x 20″ 14″ ram, 2—32″ x 30″ 1 with 15″ ram 4 openings 1 with 6″ ram 3 openings, 26″ x 45″ 10″ ram, 15″ x 15″ 8½″ ram, 1—38″ dia. 12″ ram, 200 ton, pump attached; 4 Hydraulic Cylinders Hanna Model HP 14 8″ dia. 36″ stroke, 30 ton capacity, Pumps: Robertson Triplex 5 GPM 5000 lbs., Watson Stillman duplex high and low pressure. ¾ GPM 4000 lbs. continuous motor bedplate, Hele Shaw JLP 44 GPM 1200 lbs., HPM triplex 1¾ GPM 2000 lbs. on high 16 GPM 400 lbs. on low V Belt drive, National Triplex 1″ x 3″ 4000 lbs. Extruder; No. 2 Royle Perfected, Accumulator; weighted type 5″ dia. 6′ stroke; Mills, Calenders, Mixers, etc. Advise your requirements. HIGHEST PRICES PAID FOR YOUR USED EQUIPMENT. Universal Hydraulic Machinery Company, 285 Hudson Street, New York City 13.

WANTED large quantities of plastic pearls or white round beads approximately ⅛″ in diameter. Also interested in other similar jewelry items. Reply Box 1233, Modern Plastics.

WANTED

2—54″ Mixing mills, 1—40″ mixing mill. 1—36″ Cracker with drives and motors. 1—2 roll Calender 60″ goods, 1—3 roll Calender 57″ goods, Extruders 3½″ to 10″ Royle Preferred. Reply Box 1229, Modern Plastics.

We buy usable surplus or scrap
LUCITE AND PLEXIGLAS
Can sell for immediate shipment from stock
Let us know your requirements
Midwest Waste Material Company
1947 East Kirby
Detroit 11, Michigan

WANTED

Small or medium sized Plastics Molding Plant with injection equipment with or without Tool Shop. Advise full details.

Reply 1230, Modern Plastics

WANTED

By large manufacturing company— ***Injection Molding Machine***

Reed Prentice, H.P.M. Watson Stillman or equivalent 8 or 12 ounce size preferred —are interested in any size available.

Reply 1231, Modern Plastics

NEW ENGLAND DISTRIBUTION AGENCIES WANTED—With manufacturers of plastics products of all descriptions, including industrial and commercial household items and novelties. Experienced in plastics engineering, with fifteen years' selling experience and excellent contacts in all fields of manufacturing and distribution in this area. We welcome consultation. PLASTIC DISTRIBUTORS COMPANY, P. O. Box One, Malden 48, Mass.

FOR SALE
Patent 2,367,451, Jan. 16, 1945
Heaters for extrusion nozzles.
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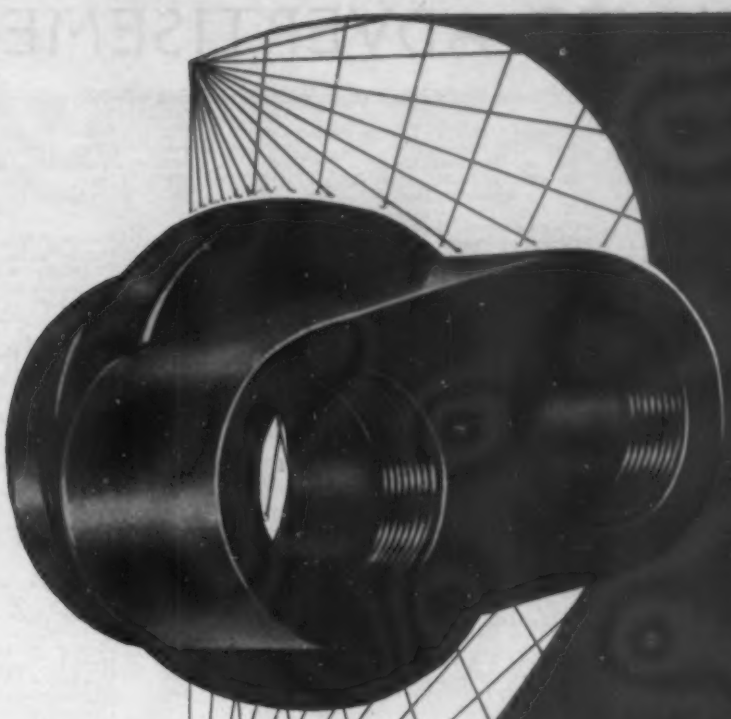

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